

Savannah River Site

High Level Waste Tank Space Management Team

Final Report (U)

WSRC-RP-99-00005

Revision: 0

August 26, 1999

**HLW Tank Space Management Team
Final Report**

Approved By:	_____	_____
	G. Abell, Systems Engineering	Date
Approved By:	_____	_____
	R. Garrett, Safety & Regulatory Engineering	Date
Approved By:	_____	_____
	P. d'Entremont, HLW Tank Farms Engineering	Date
Approved By:	_____	_____
	J. Fowler, Process Engineering	Date
Approved By:	_____	_____
	R. Fowler, Process Engineering	Date
Approved By:	_____	_____
	M. Mahoney, HLW Programs	Date
Approved By:	_____	_____
	L. Poe, Public Perceptions of HLW	Date
Approved By:	_____	_____
	R. Wilson, HLW Operations/Maintenance	Date
Approved By:	_____	_____
	M. Miller, HLW Tank Space Management Team Leader	Date
Approved By:	_____	_____
	R. Malloy, HLW Tank Space Management Team Sponsor	Date

DISCLAIMER

This report was prepared by Westinghouse Savannah River Company (WSRC) for the United States Department of Energy under Contract No. DEA-AC09-96SR18500 and is an account of work performed under that contract. Neither the United States Department of Energy, nor WSRC, nor any of their employees makes any warranty, expressed or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, or product or process disclosed herein or represents that its use will not infringe privately owned rights. Reference herein to any specific commercial product, process or service by trademark, name, manufacturer or otherwise does not necessarily constitute or imply endorsement, recommendation, or favoring of same by WSRC or by the United States Government or any agency thereof. The views and opinions or the authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

REVISION SUMMARY

<u>Rev. No.</u>	<u>Rev. Date</u>	<u>Affected Sections</u>	<u>Description of Revision</u>
0	8/26/99	All	Initial Issue

Abstract

Based on a recommendation by the Westinghouse Savannah River Company (WSRC), the Department of Energy (DOE) has decided not to operate the existing In-Tank Precipitation (ITP) Process. Because ITP is not operating, the tank space management Strategy described in the current High Level Waste (HLW) System Plan (Rev. 9)¹ is inadequate to simultaneously receive, store and process HLW. The HLW Tank Space Management Team (SM Team) was chartered to select and recommend a HLW Tank Space Management Strategy (Strategy) for the HLW Management Division of Westinghouse Savannah River Co. (WSRC) until an alternative salt disposition process is operational. Because the alternative salt disposition process will not be available to remove soluble radionuclides in HLW until 2009, the selected Strategy must assure that it safely receive and store HLW at least until 2009 while continuing to supply sludge slurry to the DWPF vitrification process.

The SM Team used the Systems Engineering (SE) process, which is described in this report to identify, evaluate and select a Strategy. Based on the results of this process, the SM Team recommends a Strategy consisting of the following actions:

- Continue to evaporate liquid waste, including the backlog waste that has not been concentrated as much as possible, throughout the period;
- Use Tank 49 for general HLW storage instead of assigning it to the ITP process;
- Install an evaporator in the DWPF salt cell to eliminate the current practice of returning DWPF aqueous byproduct waste ("DWPF Recycle") to the HLW Tank Farms;
- Return Tank 50 to HLW service in 2004 by installing a staging tank between ETF and Z Area for ETF bottoms, and operating Saltstone intermittently;
- When appropriate, implement ideas that gain small incremental volumes (less than 900 Kgal) that were identified by the SM Team as part of this work; and
- If necessary near the end of the period, incrementally reduce the minimum emergency space (presently set at 2600 Kgal for the F and H Tank Farms) to the AB minimum requirement of 1300 Kgal.

In addition to these recommended actions, other tank farm practices and plans need to be continued, such as startup of the Replacement High Level Waste Evaporator (242-25H), maintenance of tank farm infrastructure including waste tanks and associated equipment and installation, and removal of waste from older tanks.

The information provided in this report supersedes previous SM Team approved documentation.

Table of Contents

ABSTRACT	5
FIGURES	8
TABLES.....	10
1.0 EXECUTIVE SUMMARY	11
1.1 HISTORY	11
1.2 CHARTER	12
1.3 SYSTEMS ENGINEERING.....	12
1.4 DISSENTING OPINIONS.....	13
1.5 SM TEAM MEMBERS AND EXTERNAL INPUT	13
1.6 RISK MANAGEMENT	13
1.7 COST	13
1.8 RECOMMENDATION.....	14
1.9 DELIVERABLES.....	14
2.0 INTRODUCTION AND PURPOSE	16
2.1 BACKGROUND.....	18
2.2 HIGH LEVEL WASTE SYSTEM OVERVIEW	18
2.3 HLW TANK SPACE MANAGEMENT TEAM.....	22
2.4 HLW TANK SPACE TEAM SUBJECT MATTER EXPERTS (SMEs)	22
3.0 RECOMMENDED OVERALL STRATEGY	23
3.1 OVERALL STRATEGY DESCRIPTION.....	23
3.2 OVERALL STRATEGY IMPLEMENTATION.....	37
3.3 STRATEGY COSTS.....	40
3.4 STRATEGY SENSITIVITIES	41
4.0 SYSTEMS ENGINEERING PROCESS	43
4.1 IDENTIFICATION PHASE	45
4.2 EVALUATION PHASE.....	47
4.3 SELECTION PHASE.....	47
5.0 STRATEGY INPUT	48
5.1 PROBLEM DEFINITION	49
5.2 MISSION NEED	49
5.3 KEY ASSUMPTIONS	49
5.4 FUNCTIONALITY	50
5.5 REQUIREMENTS.....	55
5.6 MODELS.....	56
5.7 VALIDATION	58

6.0	IDEA IDENTIFICATION.....	59
6.1	IDEA IDENTIFICATION PROCESS	59
6.2	IDEA IDENTIFICATION RESULTS	60
6.3	IDEA CATEGORIES.....	60
6.4	IDEA SCREENING.....	61
6.5	<i>INITIAL LIST</i> OF IDEAS	62
6.6	IDEAS NOT ON " <i>INITIAL LIST</i> "	62
7.0	EVALUATION OF IDEAS	63
7.1	SPACE GAIN RANKING	63
7.2	<i>INTERMEDIATE LIST</i> IDEAS.....	75
7.3	<i>INTERMEDIATE LIST</i> OVERVIEWS	78
7.4	IDEAS NOT ON <i>INTERMEDIATE LIST</i>	78
7.5	RISK ANALYSIS OF <i>INTERMEDIATE LIST</i> IDEAS	84
8.0	STRATEGY DEVELOPMENT	90
8.1	AVAILABLE SPACE BASELINE (ASB) PROFILE	91
8.2	ELIMINATION OF COMBINATIONS WITH MUTUALLY EXCLUSIVE IDEAS	92
8.3	ELIMINATION OF COMBINATIONS OF IDEAS FAILING TO MEET THE ASB PROFILE.....	94
8.4	ELIMINATION OF DUPLICATE COMBINATIONS OF IDEAS	94
8.5	ELIMINATION OF SUPERFLUOUS COMBINATIONS OF IDEAS.....	94
8.6	IDENTIFIED STRATEGIES	94
9.0	STRATEGY DOWN-SELECTION	101
9.1	STAGE 1 SELECTION.....	101
9.2	SELECTION OF TOP FOUR STRATEGIES	110
9.3	PROCESS FOR SELECTION OF OVERALL STRATEGY	124
10.0	GLOSSARY	127
11.0	ACRONYMS.....	133
12.0	REFERENCES.....	135

Figures

FIGURE 1-1: DOCUMENTS DEVELOPED AND/OR REFERENCED IN FINAL REPORT	15
FIGURE 2-1: HLW SYSTEM MAJOR INTERFACES.....	19
FIGURE 3-1: COMPARISON OF IAS OF OVERALL STRATEGY TO IAS OF STRATEGY S-17 AND ASB REQUIREMENT	26
FIGURE 3-2: IMPACT OF OVERALL STRATEGY ON PROPOSED HLWD FUNDING (BASIS: PLANNING CASE IN REV. 10 OF THE HLW SYSTEM PLAN ¹⁹).....	42
FIGURE 4-1: HIERARCHICAL RELATIONSHIP OF THE SEMP TO OTHER SM TEAM DOCUMENTS	43
FIGURE 4-2: SYSTEM ENGINEERING PROCESS FOR STRATEGY SELECTION.....	44
FIGURE 4-3: HLW TANK SPACE MANAGEMENT STRATEGY DEVELOPMENT BUSINESS MODEL	46
FIGURE 5-1: MODEL DEPICTING STRATEGY INPUT DEVELOPMENT	48
FIGURE 5-2: HLW TANK SPACE MANAGEMENT STRATEGY TOP LEVEL FUNCTIONAL HIERARCHY	50
FIGURE 5-3: HLW TANK SPACE MANAGEMENT STRATEGY FUNCTIONAL FLOW	51
FIGURE 5-4: DETAILED FUNCTIONAL HIERARCHY FOR HLW TANK SPACE MANAGEMENT STRATEGY	52
FIGURE 5-5: HLW TANK SPACE MANAGEMENT STRATEGY ADMINISTRATIVE SOLUTION MODEL.....	56
FIGURE 5-6: HLW TANK SPACE MANAGEMENT STRATEGY UNIVERSAL FLOW SHEET MODEL.....	57
FIGURE 7-1: TIAS RANKING PROCESS FOR <i>INITIAL LIST</i> IDEAS	64
FIGURE 7-2: <i>INTERMEDIATE LIST</i> VERSUS <i>INITIAL LIST</i> RANKING PROFILE	75
FIGURE 7-3: RISK ANALYSIS PROCESS	85
FIGURE 8-1: MODEL OF INPUTS, CONTROLS, SUPPORTS AND OUTPUTS IN DEVELOPING A LIST OF STRATEGIES.....	90
FIGURE 8-2: CUMULATIVE INCREASE IN AVAILABLE SPACE NEEDED PER ASB ⁴	91
FIGURE 8-3: MATRIX OF MUTUALLY EXCLUSIVE IDEAS	93

FIGURE 9-1: MULTI-STAGE STRATEGY DOWN-SELECTION PROCESS	102
FIGURE 9-2: RANKED SCORES OF 179 STRATEGIES	106
FIGURE 9-3: EFFECT OF IDEAS ON STRATEGY SCORES.....	109

Tables

TABLE 3-1: IDEAS INCLUDED IN OVERALL STRATEGY	24
TABLE 3-2: CUMULATIVE IAS FOR THE OVERALL STRATEGY, K-GALS	25
TABLE 3-3: CUMULATIVE IAS FOR SMALL VOLUME GAIN IDEAS, K-GALS	25
TABLE 3-4: ACTIONS REQUIRED TO IMPLEMENT STRATEGY	38
TABLE 3-5: STRATEGY LIFE CYCLE COSTS (COST IN MILLIONS OF \$)	40
TABLE 3-6: IDEA COSTS BETWEEN 2000 AND 2009 (COSTS IN MILLIONS)	41
TABLE 7-1: RANKING <i>INITIAL LIST</i> BASED ON TIAS	65
TABLE 7-2: SUMMARY OF <i>INTERMEDIATE LIST</i> IDEAS BASED ON TIAS VALUES (HIGH TO LOW)	77
TABLE 7-3: “SMALL VOLUME GAINS” IDEAS	79
TABLE 7-4: RISK LEVEL (RL) DETERMINATION MATRIX	88
TABLE 8-1: HLW TANK SPACE MANAGEMENT STRATEGY LIST	95
TABLE 9-1: HLW TANK SPACE MANAGEMENT TEAM LEVEL 1 AND LEVEL 2 EVALUATION CRITERIA, ASSIGNED WEIGHTS, AND DEFINITIONS	103
TABLE 9-2: UTILITY FUNCTIONS.....	104
TABLE 9-3: TOP 18 STRATEGIES	107
TABLE 9-4: <i>INTERMEDIATE IDEAS</i> ELIMINATED FROM 179 STRATEGIES DURING FIRST DOWN-SELECT	108
TABLE 9-5: COMPARISON OF FUNCTIONALLY EQUIVALENT IDEAS.....	120
TABLE 9-6: DOWN-SELECTION FOR MANAGING DWPF RECYCLE.....	121
TABLE 9-7: DOWN-SELECTION FOR MANAGING ETF BOTTOMS	122
TABLE 9-8: EMERGENCY SPACE DOWN-SELECTION.....	122
TABLE 9-9: STRATEGIES REMAINING FOR THE <i>SHORT LIST</i>	123

1.0 Executive Summary

This section provides a summary of the activities leading to the selection of the recommended HLW Tank Space Management Strategy alternative to the HLW System Plan (Revision 9).¹ This summary describes the historical chronology, HLW Mission, the SM Team Charter, the selection process, and the recommended tank space management Strategy.

The contents of this Final Report supersede previously issued interim reports or documents produced by the SM Team.

1.1 History

The Savannah River Site (SRS) Site Treatment Plan (STP) and Federal Facilities Agreement (FFA) call for closing the HLW Tanks through vitrification of both the long-lived and short-lived radioisotopes in the Defense Waste Processing Facility (DWPF) in preparation for transport to the national high level waste repository. The In-Tank Precipitation (ITP) facility was designed and constructed to separate the cesium isotopes from the non-radioactive salts so the decontaminated salts could be disposed in a grouted wasteform at the Saltstone facility at SRS, and limit the volume of HLW glass.

The ITP process was successfully piloted both on a moderate and full-scale basis with actual SRS waste in the 1980s. During the facility radioactive startup, higher than predicted benzene releases were observed. Additional laboratory and facility tests were initiated to further investigate process chemistry issues. On January 22, 1998, Westinghouse Savannah River Company (WSRC) informed DOE that ITP chemistry testing demonstrated that the present system configuration could not cost-effectively meet the safety and production requirements for the ITP facility and recommended that a study of alternatives to the current system configuration be conducted by a systems engineering team.

In February of 1998, the Assistant Secretary for Environmental Management approved a DOE-Savannah River (DOE-SR) plan of action to suspend startup-related activities and undertake a systems engineering study of alternatives to ITP and directed WSRC to perform an evaluation of alternatives to the current system configuration for HLW salt removal, treatment, and disposal.

The HLW Salt Disposition Systems Engineering Team was chartered to systematically develop and recommend an alternative method and/or technology for disposition of HLW Salt, their recommendation, was the Small Tank TPB Precipitation process, as the preferred alternative with Crystalline Silicotitanate Non-Elutable Ion Exchange as a backup technology. DOE reviewed the WSRC recommendation and requested that WSRC pursue studies to develop a Strategy and plan to maximize existing tank space flexibility until the alternative salt process is operating.

1.2 Charter

On February 26, 1999, the HLW Salt Disposition Program Manager chartered² the HLW Tank Space Management Team (SM Team) to use the Systems Engineering (SE) approach to identify, evaluate, and recommend “the best management practices (Strategy) for safe stewardship of high level waste while maximizing available tank space”. The SM Team was sponsored by the original HLW Salt Disposition System Engineering Team.

1.3 Systems Engineering

The SE approach was required by the Charter² and recognized by the SM Team as the most appropriate method for accomplishing the assigned task. The SM Team developed a Systems Engineering Management Plan (SEMP)³ to provide a top level description of the methodology, tools, deliverables, and schedules required to implement the systems engineering approach for SM Team activities. The SEM³ served as the guidance document on how the SM Team would systematically seek out a recommended Strategy.

Implementation of the SE approach resulted in three phases of SM Team activities:

- Identification
- Evaluation
- Selection

The Identification Phase comprised, problem definition, mission need, key assumptions, necessary and sufficient functions and requirements which were defined in the Strategy Input Package (SIP)⁵. Ideas relative to tank space management were then solicited from Subject Matter Experts, Stakeholders, and SRS employees. Approximately 300 ideas were submitted, combined to eliminate duplication, categorized, and screened against “Go/No Go” criteria^{6,7}. The Identification Phase ended with the *Initial List*⁸ of ideas to be carried forward and evaluated by the SM Team.

The Evaluation Phase focused on developing the *Initial List*⁸ of concepts into detailed descriptions to facilitate combining and assessing them for space gain contributions, risk, cost/schedule to implement, impact on site missions, and compatibility with existing HLW processes. These evaluations led to the *Intermediate List*⁹ of 24 ideas and subsequent *Short List* of four Strategies.

The Selection Phase involved a review of the Evaluation Phase outputs combined with SM Team expertise to recommend a Strategy for HLW tank space management.

1.4 Dissenting Opinions

The SM Team implementation of the SE process was predicated on a consensus philosophy. If consensus was not reached by the SM Team members during any decision or phase of SM Team activities, a formal *Dissenting Opinion* vehicle existed to document the opposing view(s). The SM Team procedure⁶ for this process requires that all *Dissenting Opinions* be made part of the Final Report. There were no *Dissenting Opinions* generated during the SM Team's activities.

1.5 SM Team Members and External Input

SM Team members were chosen to provide expertise in Systems Engineering, Process Engineering, HLW Operations and Maintenance, HLW Programs, Safety and Regulatory Engineering, and HLW Tank Farm Engineering and local public perspective. WSRC engineering and administrative support resources were available to, and managed by, the SM Team as needed to complete the Chartered activities.

1.6 Risk Management

During the Evaluation Phase, risk analysis was implemented on the *Intermediate List* of ideas and *Short List* of Strategies. Subject Matter Experts (SMEs) and stakeholders participated at the request of the SM Team.

A customized checklist of risk screening questions in the areas of mission impacts, receipt, storage, processing and removal of HLW was developed and applied to each of the *Intermediate List* ideas. Statements of risk applicable to each of the ideas were documented, and qualitative estimates of probability and consequence levels for these risks were assessed. High risks were assigned risk-handling strategies. The risks were also used to eliminate *Intermediate List* ideas with high residual risks. The risk analysis was also performed on the developed Short List of Strategies, to determine if the combining of individual ideas into a Strategy resulted in new or additional unique risks. The risk analysis on Strategies produced no new notable risks.

1.7 Cost

The SM Team evaluation of cost became more detailed as the space gains and implementability of alternative Strategies became more refined. Initially, broad estimates of cost were used to see if alternatives were credible. No¹³ alternative Strategies were eliminated on this basis. Order of magnitude estimates were established based on previous experience, or in comparison to other facilities. More detailed cost estimates will be developed as scope is better defined for each of the ideas when they are closer to implementation.

1.8 Recommendation

The SM Team's recommended overall Strategy consists of the following key features:

- Continue to evaporate liquid waste, including the backlog waste that has not been concentrated as much as possible, throughout the period;
- Use Tank 49 for general HLW storage instead of assigning it to the ITP process;
- Install an evaporator in the DWPF salt cell to eliminate the current practice of returning DWPF aqueous byproduct waste ("DWPF Recycle") to the HLW Tank Farms;
- Return Tank 50 to HLW service in 2004 by installing a staging tank between ETF and Z Area for ETF bottoms and operating saltstone intermittently;
- When appropriate, implement ideas that gain small incremental volumes (less than 900 Kgal) that were identified by the SM Team as part of this work; and
- If necessary near the end of the period, incrementally reduce the minimum emergency space (presently set at 2600 Kgal for the F and H Tank Farms) to the AB minimum requirement of 1300 Kgal.

In addition to these recommended actions, other tank farm practices and plans need to be continued, such as startup of the Replacement High Level Waste Evaporator (RHLWE), maintenance of waste tanks and related equipment, and removal of waste from older tanks.

A key assumption used in the development of this Strategy was that the alternative Salt Processing Facility would be operating by the end of FY2009. If there is a delay in the alternative salt processing facility the project for the construction of new HLW tanks should be pursued, however, this would have a significant unfavorable cashflow impact.

1.9 Deliverables

This report satisfies the final report deliverable on SM Team activities and supersedes previously approved documentation issued by the SM Team. Submittal of this report completes the chartered SM Team activities. An index of references is shown in Figure 1-1 to facilitate the reading of this report.

A continued review of the implementation and optimization of this report will be made through subsequent issues of the HLW System Plan. In addition, WSRC will continue to monitor progress versus the Available Space Baseline (ASB)⁴ through programs that have been established to track and trend HLW tank farm space management.

1	"HLW System Plan (U), Rev. 9"	
2	"Charter for the HLW Tank Space Management Team"	HLW-OVP-98-0037
3	"Systems Engineering Management Plan (SEMP)"	HLW-SDT-99-0022
4	"Available Space Baseline for HLW SM Team Initiative" (ASB)	WSRC-RP-99-0003
5	"Strategy Input Package (SIP)"	HLW-PMD-99-0027
6	"Desktop Procedures - Compendium"	HLW-SDT-99-0036
7	"Results Report on the Identification of Concepts to Manage HLW Storage Space"	HLW-SDT-99-0189
8	"Results Report on the Determination of Initial List Ideas"	HLW-SDT-99-0055
9	"Results Report on the Intermediate List of Ideas Based on Space Gain Contributions"	HLW-SDT-99-0063
10	"Results of the HLW Tank SM Team Criteria Selection, Weighting, Utility Functions and Values, for Strategy Evaluations"	HLW-SDT-99-0066
11	"Sensitivity Analysis for HLW SM Team"	SRT-SCS-99-0167
12	"Results Report on the Risk Analysis of Intermediate List Ideas"	HLW-SDT-99-0050
13	"Life Cycle Cost Estimate of Intermediate List Ideas"	HLW-SDT-99-0147
14	"Macro/Spreadsheet for Strategy Development"	HLW-SDT-99-0203
15	"Results of the Software Verification for Spreadsheets and Macros Implementing the SM Team Strategy Evaluation"	HLW-SDT-99-0233
16	"Results Report on the Development of Tank Space Management Strategies"	HLW-DEN-99-0207
17	"Results Report on the Application of Weighted Evaluation Criteria"	HLW-SDT-99-0220
18	"HLW Salt Disposition Team Final Report"	WSRC-RP-99-0218
19	"HLW System Plan (U), Rev. 10"	HLW-SDT-99-0008

*Desktop Procedure Compendium includes the following:

Title	Document No.
• Desktop Procedure for Document Control	HLW-SDT-980021
• Desktop Procedure for the Development, Approval and Control of Desktop Procedures	HLW-SDT-980025
• Desktop Procedure for Information Handling, Analysis, and Reporting	HLW-SDT-980028
• Desktop Procedure for the Identification and Documentation of Dissenting Opinions	HLW-SDT-980030
• Desktop Procedure for the Training of Personnel	HLW-SDT-980036
• Desktop Procedure for HLW Salt Disposition Team Records and Document Management and Storage	HLW-SDT-980045
• Desktop Procedure for Change Control	HLW-SDT-980048
• Desktop Procedure for Team Reports	HLW-SDT-980051
• Desktop Procedure for Engineering Change Control	HLW-SDT-980053
• Desktop Procedure for the Application of Screening Criteria	HLW-SDT-990035
• Desktop Procedure for the Identification of Concepts to Manage HLW Storage Space	HLW-SDT-990039
• Desktop Procedure for Dispositioning the Initial List Ideas Based on Available Space Contributions	HLW-SDT-990044
• Desktop Procedure for Risk Analysis	HLW-SDT-990053
• Desktop Procedure for the Application of Weighted Evaluation Criteria	HLW-SDT-990082
• Desktop Procedure for Strategy Development	HLW-SDT-990177
• Desktop Procedure for the HLW Tank Space Strategy Selection Process	HLW-SDT-990221

Figure 1-1: Documents Developed and/or Referenced in Final Report

2.0 Introduction and Purpose

The SRS Site Treatment Plan (STP) and Federal Facilities Agreement (FFA) call for closing the HLW Tanks through vitrification of both the long-lived and short-lived radioisotopes in DWPF in preparation for transport to the national high level waste repository. To make this program economically feasible, it is necessary to limit the volume of HLW glass produced by removing much of the non-radioactive salts and incidental wastes for disposal as saltstone. The ITP facility was designed and constructed to separate the cesium isotopes from the non-radioactive salts so the decontaminated salts could be disposed in a grouted wasteform at the Saltstone facility at SRS.

The ITP process was successfully piloted both on a moderate and full-scale basis with actual SRS waste in the 1980s. During the facility radioactive startup, higher than predicted benzene releases were observed. Additional laboratory and facility tests were initiated to further investigate process chemistry issues. In January 1998, conclusions were drawn from the test program that the benzene release rates associated with facility operation could exceed the capability of the current plant hardware/systems. On January 22, 1998, WSRC informed DOE that ITP chemistry testing demonstrated that the present system configuration could not cost-effectively meet the safety and production requirements for the ITP facility and recommended that a study of alternatives to the current system configuration be conducted by a systems engineering team.

On February 6, 1998, the Assistant Secretary for Environmental Management approved a DOE-SR plan of action to suspend startup-related activities and undertake a systems engineering study of alternatives to ITP. On February 20, 1998, DOE-SR concurred with the WSRC evaluation of the ITP chemistry data, instructed WSRC to suspend ITP startup preparations, and directed WSRC to perform an evaluation of alternatives to the current system configuration for HLW salt removal, treatment, and disposal.

In March 1998, a WSRC-sponsored High Level Waste Systems Engineering Team was formed to study alternatives to the ITP processes as well as methods to enhance the current process. The multi-disciplined Team was chartered with the task of “systematically developing and recommending an alternative method and/or technology

On October 29, 1998, the WSRC HLW Systems Engineering Team provided their recommendation to the DOE. The recommendation was to pursue the Small Tank TPB precipitation process as the preferred alternative and Crystalline Silicotitanate Non-Elutable Ion Exchange as a backup technology.

On January 28, 1999, the DOE completed their review of the recommendation and developed a path forward, which requested WSRC to take six actions as described below:

- 1) Initiate actions necessary to support the NEPA (Supplemental EIS) process (e.g., evaluate effects on Saltstone Performance Assessment (PA) from the variations in the feeds from the three alternatives and provide support as needed to resolve issues identified.
- 2) Expand Tank Farm water/salt management studies and develop a Strategy and plan to maximize existing tank space flexibility in order to accommodate any of the alternatives.
- 3) Perform parallel research and development (R&D) activities to address the technical uncertainties associated with the Crystalline Silicotitanate (CST) Ion Exchange and Small Tank Tetraphenylborate (TPB) Precipitation alternatives.
- 4) Evaluate the use of existing Tank Farm facilities for the removal of uranium, plutonium, neptunium and strontium from the HLW salt solutions.
- 5) Provide support to DOE-SR as needed for the Direct Disposal in Grout alternative, including any necessary R&D activities.
- 6) Initiate further design development only for issues that are common to all alternatives.

On February 26, 1999, the WSRC HLW Salt Disposition Program Manager chartered the HLW Tank Space Management Team (SM Team) to address the second item defined above.

The charter for the SM Team identified the following deliverables:

- A HLW System Analysis with bases
- Proposed and drafted permit changes
- Approved baseline changes to the HLW Salt Disposition Systems Engineering Team controlled documents
- An overview of the SM Team activities and process used.
- Because the Salt Disposition Facility will not be operational for about a decade, HLW System Plan (Rev. 9)¹, which assumes that ITP will be operational, is obsolete. Thus, the HLW Tank Space Management Team was chartered² to apply the Systems Engineering process to identify, evaluate, and recommend a Strategy that provides for the safe and cost effective space management of HLW

This report constitutes the “Final Report” required by the SM Team Charter.

2.1 Background

High Level Waste has been produced at the Savannah River Site since 1954. This waste was stored in Interim Waste Tanks. In the early 1980s, a concept was developed to no longer construct additional Interim Waste Tanks, but to process the waste into a safer storage form, reduce risk, and ready the waste for permanent storage. This led to an initial design concept for DWPF and an Ion Exchange Facility.

The cost for both facilities was high, and technical uncertainties for Ion Exchange posed a high risk. Alternatives to the Ion Exchange Process were evaluated and the ITP process was selected due to lower projected cost and technical risk.

The Savannah River Site currently stores 34 million gallons of HLW in Interim Storage Tanks. This activity is considered to be one of the higher risk activities on the Site. The FFA and STP require removing the waste from the high level waste tanks to resolve several safety and regulatory concerns. The “old style” tanks (tanks 1 – 24), do not meet EPA secondary containment standards for storage of hazardous waste, (effective January 12, 1987). Several of the “old style” tanks have leaked observable quantities of waste from primary to secondary containment. Other tanks have known penetrations above the liquid level, although no waste has been observed to leak through these penetrations. The 34 million gallons of liquid waste stored in the HLW tanks are composed of 31 million gallons of salt and 3 million gallons of sludge. The process to treat and vitrify sludge has been operational since December 1995. The ITP process was the baseline method intended for handling salt.

The WSRC HLW Salt Disposition Systems Engineering Team completed their chartered activities and presented their recommendations to DOE on October 29, 1998. The DOE requested additional studies and environmental impact evaluations to be done. The net effect of the suspension of ITP, and additional studies is a delay in HLW salt processing of about eight to ten years.

2.2 High Level Waste System Overview

Any new HLW Tank Space Management Strategy must consider the interfaces with existing facilities, and the ease or difficulty of the successful implementation of an alternative technology as governed by how well it will integrate into the existing HLW System.

The mission of the HLW System is to receive and store SRS high level wastes in a safe and environmentally sound manner and to convert these wastes into forms suitable for final disposal. The planned forms are:

- borosilicate glass to be sent to a Federal Repository

- saltstone to be disposed of on site
- treated wastewater to be released to the environment.

Also, the storage tanks and facilities used to process the high level waste must be left in a state such that they can be decommissioned and closed in a cost-effective manner and in accordance with appropriate regulations and regulatory agreements.

The HLW System is a set of seven different interconnected processes (Figure 2-1) operated by the High Level Waste and Solid Waste Divisions. These processes function as one large treatment plant that receives, stores, and treats high level wastes at SRS and converts these wastes into forms suitable for final disposal.

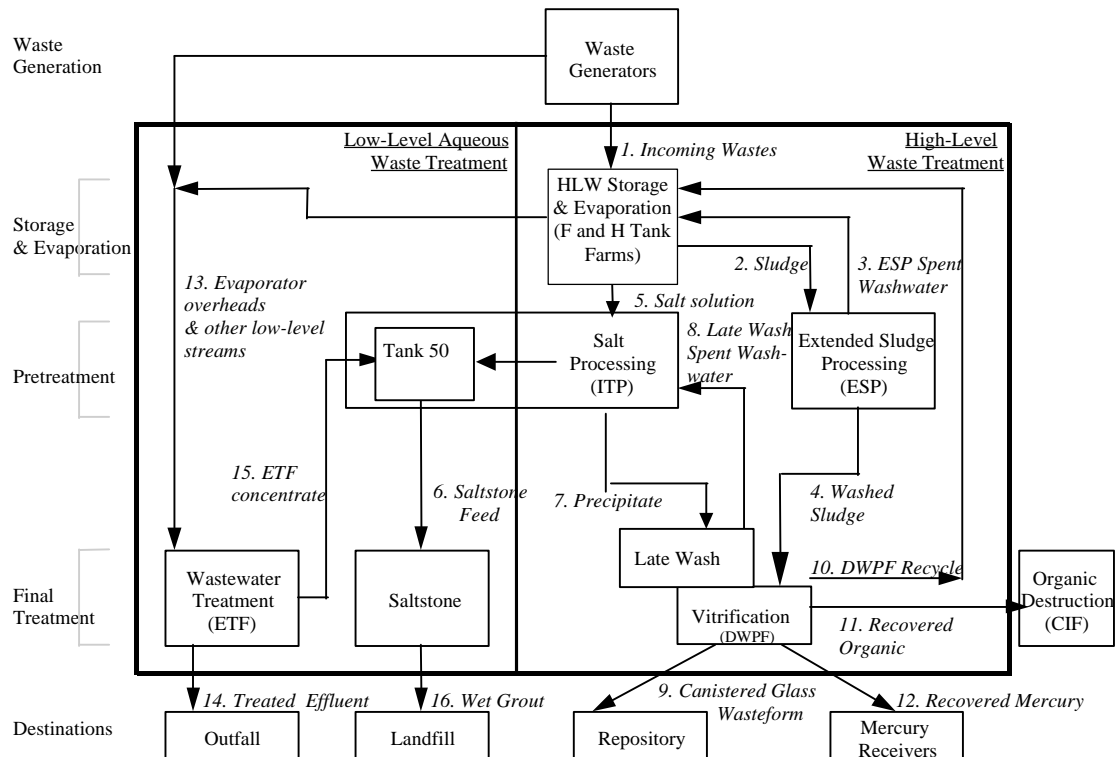


Figure 2-1: HLW System Major Interfaces

These processes currently include:

- High Level Waste Storage and Evaporation (F and H Area Tank Farms)
- Salt Processing (In Tank Precipitation and Late Wash Facilities)

- Sludge Processing (Extended Sludge Processing Facility)
- Vittrification (DWPF)
- Wastewater Treatment (Effluent Treatment Facility)
- Solidification (Saltstone Facility)
- Organic Destruction (Consolidated Incineration Facility)

F and H Area Tank Farm, Extended Sludge Processing, DWPF, Effluent Treatment Facility, Saltstone Facility, and the Consolidated Incineration Facility are all operational. ITP Facility operations are limited to safe storage and transfer of materials. The Late Wash Facility has been tested and is in a dry lay-up status.

All high level wastes in storage at SRS are classified Land Disposal Restrictions (LDR) wastes, which are prohibited from permanent storage. Since the planned processing of these wastes will require considerable time and therefore continued storage of the waste, DOE has entered into a compliance agreement with the EPA and SCDHEC. This compliance agreement is implemented through the STP, which requires processing of all the high level waste at SRS according to a schedule negotiated between the parties.

Figure 2-1 schematically illustrates the routine flow of wastes through the HLW System. The various processes within the system and external processes are shown in rectangles. The numbered streams identified in italics are the interface streams between the various processes. The discussion below represents the HLW System configuration as of January 1998.

Incoming high level wastes are received into HLW Storage and Evaporation (F and H Area Tank Farms) (Stream 1). The function of HLW Storage and Evaporation is to safely concentrate and to store these wastes until downstream processes are available for further processing. The decontaminated liquid from the evaporators are sent to Wastewater Treatment (ETF) (Stream 13).

The insoluble sludges that settle to the bottom of waste receipt tanks in HLW Storage and Evaporation are slurried using hydraulic slurring techniques and sent to Extended Sludge Processing (ESP) (Stream 2). In ESP, sludges high in aluminum are processed to remove some of the insoluble aluminum compounds. All sludges, including those that have been processed to remove aluminum, are washed with water to reduce their soluble salt content. The spent washwater from this process is sent back to the HLW Storage and Evaporation (Stream 3). The washed sludge is sent to Vittrification (DWPF) for feed pretreatment and vittrification (Stream 4).

Saltcake is redissolved using hydraulic slurring techniques similar to sludge slurring. As currently designed, the salt solutions from this operation, and other

salt solutions from HLW Storage and Evaporation, were intended for feed to Salt Processing (Stream 5). In ITP, the salt solution would be processed to remove radionuclides, which are concentrated into an organic precipitate. The decontaminated filtrate would then be sent to Tank 50. A concentrated organic precipitate, containing most of the radionuclides, is produced by the process. This precipitate is washed with water to remove soluble salts. However, some soluble corrosion inhibitors that interfere with DWPF processing must be left in the precipitate after washing because the precipitate is stored in carbon steel tanks, which are susceptible to corrosive attack by uninhibited precipitate wastes.

The precipitate is transferred to Late Wash for further washing in stainless steel tanks to reduce the level of soluble corrosion inhibitors to acceptable levels for the DWPF process (Stream 7). The washwater from this process is returned to ITP to be reused in the ITP process (Stream 8).

The washed precipitate from Late Wash is then sent to the DWPF vitrification building (221-S). In the vitrification building, the precipitate is catalytically decomposed and separated into two streams: a mildly contaminated organic stream and an aqueous stream containing virtually all of the radionuclides. The mildly contaminated organics are stored at DWPF and eventually transferred to Organic Destruction (CIF) (Stream 11). The aqueous stream is combined with the washed sludge from ESP, which has undergone further processing and the mixture vitrified.

The washed sludge from ESP (Stream 4) is chemically adjusted in the DWPF to prepare the sludge for feed to the glass melter. As part of this process, mercury is stripped out, purified, and sent to mercury receivers (Stream 12). The aqueous product from organic decomposition is added to the chemically adjusted sludge. The mixture is then combined with glass frit and sent to the glass melter. The glass melter drives off the water and melts the wastes into a borosilicate glass matrix, which is poured into a canister. The canistered glass wasteform is sent to site interim storage, and will eventually be disposed of in a Federal Repository (Stream 9).

The water vapor driven off from the melter along with other aqueous streams generated throughout the DWPF vitrification building is recycled to HLW Storage and Evaporation for processing (Stream 10).

Overheads from the HLW Storage and Evaporation evaporators are combined with overheads from evaporators in the F and H Area Separations processes and other low-level streams from various waste generators. This mixture of low-level wastes is sent to the ETF (Stream 13).

In the ETF, these low-level wastes are decontaminated by a series of cleaning processes. The decontaminated water effluent is sent to the H Area outfall and

eventually flows to local creeks and the Savannah River (Stream 14). The contaminants removed from the water are concentrated and sent to Tank 50 (Stream 15).

In Tank 50, the concentrate from the ETF is combined with the decontaminated filtrate from the ITP and sent to Saltstone (Stream 6). In the Saltstone Facility, the liquid waste is combined with cement formers and pumped as a wet grout to a vault (Stream 16). In the vault, the cement formers hydrate and cure, forming a saltstone monolith. The Saltstone Facility vaults will eventually be closed as a landfill.

2.3 HLW Tank Space Management Team

The WSRC HLW Salt Disposition Program Manager (Steve Piccolo) selected the members of the HLW Tank Space Management Team in accordance with the requirements of the Charter². Members are identified below by area of contribution and organizational affiliation. The focus of the SM Team Charter was to recommend a Strategy for the management of HLW storage space until at least the year 2009.

<u>NAME</u>	<u>AREA OF CONTRIBUTION</u>	<u>AFFILIATION</u>
Robert Malloy	Team Sponsor*	WSRC
Marshall Miller	Team Leader**	WSRC
Gary Abell	Systems Engineering	WSRC
John Fowler	Process Engineering & Chemistry	WSRC
Rick Fowler	Process Engineering	WSRC
Paul d'Entremont	HLW Tank Farms Engineering	WSRC
Richard Garrett	Safety and Regulatory Engineering	WSMS
Mark Mahoney	HLW Programs	WSRC
Lee Poe	Public Perceptions of HLW	Consultant
Robert Wilson	HLW Operations/Maintenance	WSRC

* The SM Team Sponsor acted as a formal liaison between the HLW Salt Disposition Systems Engineering Team and the SM Team.

** The SM Team Leader acted as the formal point of contact with the WSRC Program Manager and DOE.

2.4 HLW Tank Space Team Subject Matter Experts (SMEs)

The SM Team utilized various SMEs in the process. These individuals provided technical, maintenance, operation, and regulatory expertise.

3.0 Recommended Overall Strategy

The SM Team's recommended Overall Strategy is discussed in this section. The implementation plans, costs, schedules and uncertainties associated with the Overall Strategy are included. The Overall Strategy will provide a safe and cost-effective means to manage High Level Waste (HLW) at the SRS through FY2009. The Systems Engineering methodology and the results used to identify, evaluate and select the Overall Strategy are discussed in Sections 4.0 through 9.0 of this report.

A key assumption used to develop the Overall Strategy is that the new Salt Processing Facility will be operational by the end of FY2009. The Overall Strategy combines Strategy S-17 (as described in Section 9.3) with the Small Volume Gain Ideas (SVGI) described in Section 7.4. The Overall Strategy provides these advantages for managing HLW through 2009:

- (1) Minimal impact on cash flow and budgets compared to the HLWMD Base Case Planning Model.
- (2) Slightly higher Increase in Available Space (IAS) than required in all years over the entire ten-year study period. Higher IAS provides some flexibility in operations and will offset unexpected increases in waste volumes or other events not anticipated by the SM Team.
- (3) A flexible schedule that delays a reduction in Emergency Space until late in the study period, and the Emergency space would only be implemented if space is needed to continue Tank Farm operations.
- (4) The use of existing facilities and processes is maximized.

Failure to implement the Overall Strategy or to assure the Salt Processing Facility is operational by FY2009 could lead to a significant increase in the Life Cycle Costs for managing and disposal of the HLW now stored in waste tanks at the SRS. If the significant delays occur in the project for the Salt Processing Facility, an additional major project to construct four HLW waste tanks on an accelerated schedule would be required to assure additional storage space is available beyond FY2009.

3.1 Overall Strategy Description

The initiatives included in the Overall Strategy are shown in Table 3-1. The Overall Strategy continues the current practice to recover space in the Tank Farm by evaporation of current and future waste to higher salt concentrations. Work must begin in FY2000 to implement the Small Volume Gain Ideas (SVGI), to recover and reuse Tanks 49 (IL-22) and 50 (IL-21) for HLW storage and to design and install an evaporator in the DWPF Salt Cell (IL-11) to eliminate DWPF recycle as an influent to the Tank Farm. As noted above, Emergency Space would be reduced to the Authorization Basis (AB) minimum value of 1300 K-gal (IL-17) only if necessary to continue Tank Farm Operations.

Table 3-1: Ideas Included in Overall Strategy

Ideas	Fiscal Year IAS Occurs	Total IAS Gained, K-gals
Continue to Evaporate Waste (IL-10)	2000-20 09	1,526
Implement Small Volume Gain Initiatives (ideas < 900 K-gal each)	2000-20 09	2,083
Recover and Reuse Tank 49 (IL-22)	2001	1,060
Eliminate DWPF Recycle to HLW Tank Farm by Acid Evaporation of DWPF Recycle in Salt Cell (IL-11)	2004-20 09	1,176
Return Tank 50 to HLW Service By Installing a New Tank for Staging of ETF Bottoms to be sent to Z Area (IL-21)	2004	1,200
Reduce 2.6 M-gals Emergency Space to 1.3 M-gal (AB Limit) (IL-17)	If needed	1,300

The SVGI used in the Overall Strategy include these ideas:

- Reevaluate the specifications contained in the Tank Farm WAC and remove excess conservatism to minimize the quantity of salt added to incoming wastes.
- Add telescoping jets to some HLW Tanks to allow more complete transfers thus minimizing heels of waste that is not concentrated as much as possible.
- Use HLW supernate with high caustic molarity for aluminum dissolution.
- Review DWPF operations and change current practices to minimize recycle to Tank Farm such as reducing steam flow to the melter off-gas system during periods of melter shutdown, bypassing the Low Point Pump Pit to minimize pump priming, and repairing the pump priming line on the SMECT transfer pump. *[Note: Gains from these ideas can only be realized until evaporation of DWPF aqueous waste begins (i.e., before Idea IL-21 is implemented).]*
- Use Tank 26F for concentrated supernate storage after placing the 2F Evaporator in warm standby, thus reducing the working space required for continuing operations in the Tank Farm.
- Use Type IV tanks to store dilute spent wash water from ESP.

Table 3-2 summarizes the IAS from each idea in the Overall Strategy and compares it to the Annual Space Baseline (ASB) Requirement that served as the basis for evaluating strategies in this study. Emergency Space is reduced in FY2007 in Table 3-2 to yield the maximum cumulative IAS for the Overall Strategy, but this reduction may not be needed if the projected volume gains from all other ideas are realized or waste influents are less than forecasted. The

projected ten-year IAS for the SVGI (up to 2100 K-gal) more than compensates for the IAS that would be provided by reducing Emergency Space to the AB minimum value (1300 K-gal). Conversely, if the projected IAS from the SVGI or any other idea cannot be fully achieved, reducing Emergency Space provides buffer capacity for the overall IAS.

Table 3-2: Cumulative IAS for the Overall Strategy, K-gals

Ideas in Overall Strategy	Fiscal Year									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Continue to Evaporate Waste (IL-10)	759	1526	1526	1526	1526	1526	1526	1526	1526	1526
Implement Small Volume Gain Ideas	15	393	665	879	928	977	1285	1599	1713	2083
Recover & Reuse Tank 49 (IL-22)	0	1060	1060	1060	1060	1060	1060	1060	1060	1060
Eliminate DWPF Recycle to HLW Tank Farm by Acid Evaporation of DWPF Recycle in Salt Cell (IL-11)	0	0	0	0	196	392	588	784	980	1176
Return Tank 50 to HLW Service By Installing New Tank for Staging of ETF Bottoms for Z Area (IL-21)	0	0	0	0	1200	1200	1200	1200	1200	1200
Reduce 2.6 M-gals Emergency Space to 1.3 M-gal (AB Limit) (IL-17)	0	0	0	0	0	0	0	1300	1300	1300
Cumulative IAS	774	2979	3256	3469	4943	5203	5656	7475	7735	8250
ASB Requirement	500	1378	1944	2419	2783	3378	3886	4987	5299	6043

The SM Team stresses the importance of the SVGI to achieve the IAS projected for the Overall Strategy. The projected cumulative IAS from the SVGI for each Fiscal Year is shown in Table 3-3.

Table 3-3: Cumulative IAS for Small Volume Gain Ideas, K-gals

Initial List Ideas Used for SVGI (Idea No.)	Fiscal Year									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Modify Practices Related to DWPF Recycle and Operations (D-19, D-28, D-30)	15	38	61	84	84	84	84	84	84	84
Add Telescoping Transfer Jets to Evaporator System Tanks (T-13)		300	500	500	500	500	500	500	500	500
Revise Tank Farm WAC to Reduce Excess Inhibitors (A-18)	0	48	96	144	192	240	288	336	384	48
Optimize ESP Washing Using DWPF Recycle (W-33)	0	7	7	14	14	14	14	14	14	14
Use High Caustic Waste for Al-Dissolution (W-29)	0	0	0	135	135	135	329	329	329	585
Shutdown 2F Evaporator System (T-87)	0	0	0	0	0	0	0	200	200	200
Other (C-20, T-24, A-12, A-13, A-14, T-9)	0	0	1	2	3	4	5	6	7	8
Cumulative IAS	15	393	665	879	928	977	1285	1599	1713	2083

Figure 3-1 compares the Overall Strategy's IAS from Table 3-2 with the IAS for Strategy S-17 and the ASB Requirement. The top curve shows the maximum space gain from the Overall Strategy and is based on the assumption that all of the initiatives are fully implemented, including the reduced Emergency Space (IL-17) in FY2007. The middle curve shows the IAS for Strategy S-17 without the SVGI included. The bottom curve shows the ASB Requirement used for this study. The SM Team stresses the importance of the Small Volume Gains to achieve the IAS projected for the Overall Strategy. The SM Team judged that the magnitude of uncertainty associated with the IAS is represented by the difference between the curve for the Overall Strategy and the curve for Strategy S-17 shown in Figure 3-1.

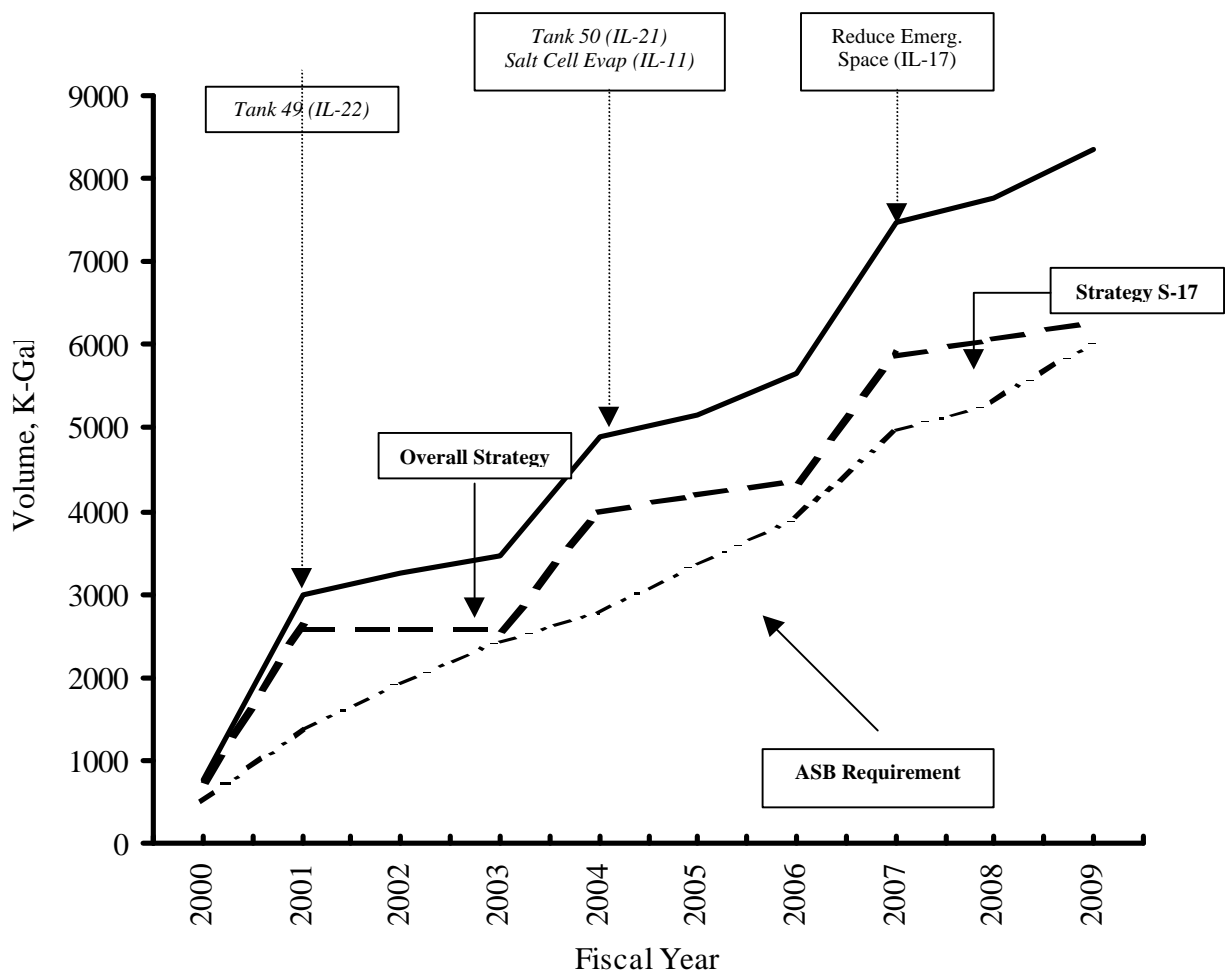


Figure 3-1: Comparison of IAS of Overall Strategy to IAS of Strategy S-17 and ASB Requirement

3.1.1 Evaporate Waste

This Idea (IL-10) continues the current Tank Farm operations using HLW evaporators to gain approximately 1,500K gal of space in the Tank Farm. Volume gained from this idea comes from evaporating approximately 3,500K gal of waste now stored in Tanks 30, 35, 39 and 40. Salt solution has been stored in these tanks for several years in anticipation of providing feed to the In-Tank Precipitation (ITP) process. With the delay of salt solution processing due to safety issues surrounding ITP, this "backlog waste" should be further evaporated to increase the available space in the Tank Farm.

The idea for evaporation of backlog waste is in every Strategy evaluated by the SM Team. Implementation of this idea began in FY99 when Tank 35 material was transferred to Tank 32 in July 1999. This idea relies on normal waste transfers and evaporation in the Tank Farm.

Though new procedures must be developed to process the waste already in the Tank Farm, no new equipment is required to implement this idea for the space gain value specified above. However, the number of transfers made in the Tank Farm annually must increase significantly. For example, the planned FY2000 tank-to-tank transfers to evaporate the backlog waste and to prepare Sludge Batch 2 are about triple the number of transfers made over the last three years combined.

The logistics of increasing available space by evaporating backlog waste while also supporting other key activities (e.g., DWPF processing) will be a major challenge for HLWD. In addition, the 2F Evaporator is nearing the end of its design life while the RHLWE (3H Evaporator) is still in a startup mode and was assumed to be operational by October 1999 for this study.

Principal risks for this idea are related to availability of evaporators for processing the waste and infrastructure to transfer waste to an evaporator feed tank when additional feed is needed. If the 2F, 2H and 3H evaporators can not operate as planned, the ability to gain space from evaporating waste would be severely reduced. If the planned IAL for IL-10 is not achieved, then other processing impacts could occur. The most notable impact would occur in FY2000. If available space cannot be increased by evaporation, Sludge Batch 2 processing could be delayed unless other IAS ideas are implemented (e.g. use of Type IV tanks for ESP wash water storage).

Longer-term, failure to evaporate dilute waste could result in a “water-logged” condition in the HLW Tank Farm System. If this occurs, other Site operations must shut down because waste storage space for new receipts or pretreatment operations is unavailable. Processes that could be affected include NMSS Processed Waste, DWPF, and sludge washing operations in ESP.

3.1.2 Small Volume Gain Ideas (SVGI)

As described in Section 6.4, fifteen ideas were identified that have the potential to yield small increases in available space. These fifteen ideas fall into two main categories. Some provide small volume gains ranging up to about 600 K-gal. Others suggest better mechanisms (e.g., by changing operating practices or develop better tracking indicators) that should be evaluated further. Even if the space gains from these ideas are small, they could result in better space forecasting to better manage the available space. If successfully implemented, the small volume gain ideas could also result in overall cost savings if they eliminate the need for other more costly space gain ideas. For example, the successful implementation of all the SVGI is estimated to provide an increase in TIAS of up to 2 million gallons. This IAS could eliminate the need for reducing the Emergency Space from its current value of 2.6 million gallons.

Overall, the SM Team recommends that each of the fifteen ideas be evaluated further and implemented where appropriate. Although individually these ideas may not provide significant space savings, their collective implementation could provide the equivalent of at least one HLW Waste Tank. In addition, implementation of the SVGI demonstrates HLW’s proactive search for ways, both large and small, to increase the available space in the Tank Farms. Submission of new ideas is encouraged and will be added to the list for evaluation, as appropriate.

The small volume space gain ideas are listed in Table 7-3 of this report. Some of the more promising SVGI are described in more detail below.

- *Perform Aluminum Dissolution with High Hydroxide Waste*

This idea proposes to use existing concentrated supernate that is high in OH^- for aluminum dissolution rather than adding fresh sodium hydroxide. If successfully implemented, the loss of approximately 600 K-gal of available space is avoided by eliminating the addition of new salt and sodium hydroxide during the Al dissolution process. The cumulative IAS is realized through 2009 from Sludge Batches 3, 4 and 5. This idea should be relatively inexpensive to implement. New procedures and some minimal physical modifications to

transfer routes may be required, depending on the source tank for the concentrated supernate. This idea results in similar space savings for all sludge batches requiring aluminum-dissolution through the entire life-cycle of the sludge processing program.

Risks associated with this idea are as follows:

- ◆ Tanks containing high hydroxide supernate may not be available when they are needed,
- ◆ Tank Farm infrastructure can not support needed transfers, and
- ◆ The amount of aluminum to be dissolved requires a longer period to process, thereby extending the time needed to prepare a sludge batch.

- *Install Telescoping Transfer Jets (TTJ) in Selected Tanks*

Some of the fixed height transfer jets are set too high and will not allow complete removal of supernate to enable full evaporation of existing waste. Because of this condition, several tanks contain supernate that has not been fully concentrated. For example, the existing fixed-height transfer jet in Tank 35 is at a level of 150 inches from the tank bottom. If a new TTJ were installed in Tank 35, up to an additional 300 K-gal of space could be gained by evaporation of the additional supernate that could be removed from the tank.

In addition, installing a TTJ in each evaporator feed tank and each concentrate receipt tank may improve evaporator efficiency. By adjusting the height of the TTJ appropriately, evaporator feed could be drawn from the lower density supernate layers in tanks to promote higher space gain through improved evaporator efficiency. A combined chemistry and corrosion probe is also being developed for use in HLW tanks to enable real-time chemical analysis and on-line measurement of corrosion susceptibility. The prototype for this probe is planned for installation in FY00. If the probe is successfully demonstrated, it should provide the information needed to size the lengths of transfer jets to optimize evaporator operations.

The principal risk associated with this idea is difficulty (cost, radiation control concerns, etc.) in the removal and disposal of an existing jet and in the subsequent installation of a new TTJ in the required riser. These difficulties have been encountered with the installation of a new jet in Tank 8 for waste removal.

- *Revise Tank Farm Waste Acceptance Criteria (WAC)*

This idea proposes to revise the Tank Farm WAC to eliminate or modify practices that can affect space negatively, especially excess caustic additions and dilutions imposed on NMSS waste receipts and DWPF recycle waste receipts. The Tank Farm WAC requires sufficient caustic to be added to NMSS waste to yield a neutralized solution containing at least 1.2 M excess caustic (NaOH). DWPF recycle waste must be neutralized to 0.5 M NaOH. Caustic is added to the waste before it is transferred to assure the tank chemistry is not altered when the waste is added to a tank. Uncertainty related to splashing of waste on the walls above the liquid level and the inability to determine how well the new waste mixes with existing waste in the tank has led to these stringent specifications. Improved monitoring of tank chemistry (e.g. the combined chemistry and corrosion probe described above) may allow the concentration of inhibitors to be reduced in waste sent to the Tank Farm. Down-comers could also be installed to eliminate splashing and mixing concerns.

The risks associated with this idea include additional chemical monitoring requirements after a waste transfer. Additional metallurgical tests may also be required to assure that a reduction in the caustic concentration (or the concentration of other inhibitors) would not increase the risk of higher corrosion rates in the Tanks.

- *Implement Several Ideas to Reduce the volume of DWPF Recycle*

There are several ideas included in Table 6-3 that would reduce the volume of DWPF recycle waste sent to the Tank Farm. Although the DWPF recycle stream has low salt concentration and can be easily evaporated, the inhibitors that must be added to this high volume stream to meet the Tank Farm WAC result in concentrate that eventually takes up space in the Tank Farm. Therefore, even small reductions in the total amount of DWPF recycle sent to the Tank Farm can result in space saved until an evaporator is installed in the DWPF to divert the recycle stream or salt processing is initiated.

The risks associated with these ideas include the costs, radiation concerns and remote replacement of equipment in an operating facility. These ideas requires new equipment to be purchased for various DWPF transfer pumps to reduce flushes, installation of a jumper in the Low Point Pump Pit to bypass the tank and eliminate multiple primes for each transfer and a reduction in the steam flow to the Melter Off-Gas system. The change to the Melter Off-Gas system will also require a test to confirm the required decontamination of the Melter off-gas is achieved at reduced steam flow to the scrubbers.

- Reclaim Space in Tank 26F by Placing the 2F Evaporator in Standby

Several conditions in the HLW System planning could lead to placing the 2F Evaporator in warm standby. These conditions include the following:

- (1) The Replacement High Level Waste Evaporator is successfully started and operating as planned.
- (2) The 2H evaporator continues to operate as planned.
- (3) Salt space in Tank 46F is not needed to achieve the required IAS.
- (4) Influent from F-Canyon processing do not increase significantly (beyond the forecast used as part of the basis for this study).

If all of these conditions are satisfied, then the 2F Evaporator could be placed in warm standby. The remaining space in the 2F Evaporator feed tank (26F) and the Evaporator receipt tank (46F) would then be available for storing concentrated supernate from H Area evaporators.

Before this idea can be implemented, all of the conditions listed above must be satisfied. The principal risk associated with this idea is that all conditions will not be satisfied before FY2010.

- Use Tank 23H and 24H for Storage of Spent Wash Water from ESP Processing

A significant volume of dilute wash water containing low concentrations of radionuclides is expected to be generated from ESP processing of Sludge slurry. Present plans to manage available space uses Type IV tanks in H Area (Tanks 21H and 22H) to store DWPF recycle and/or spent wash water until it can be processed through an evaporator system. This idea proposes to also use Tanks 23H and 24H to store dilute waste. However, this idea would simply leave the waste in these two tanks until the Salt Processing Facility is operational. Use of these two tanks in this manner would be deferred until late in the time period of interest (beyond FY2006), receiving spent wash water from the preparation of Sludge Batches 4 and 5.

The principal risk associated with this idea is that the activity in this waste would be too high to allow overland transfer to these tanks from Tank 21 or Tank 22. If the activity is too high, then a valve box would have to be installed to handle the transfers. Using these tanks in this manner may also delay their retirement and closure.

3.1.3 Recover Tank 49 for High Level Waste Storage

Tank 49 has about 100,000 gallons of High Level Waste containing a small amount of sodium tetraphenylborate (NaTPB) and associated decomposition products from the initial ITP demonstration run in 1984. In December 1998, during testing of the Distributive Control System, the tank ventilation system was secured to determine the rate of benzene generation in the Tank. A benzene generation rate that was greater than allowed within the approved facility authorization basis for air-based mode of operation was detected during this test.

The tank vapor space was converted to nitrogen-based operation (inert atmosphere). In accordance with the Justification for Continued Operations (JCO) that was issued, the waste is sampled and analyzed periodically to measure the rate of decomposition of the organic materials. The JCO requires the tank's vapor space to remain in nitrogen-based operation until such time the benzene generation rate has slowed to a rate that allows tank operations in an air-based mode.

- Actions Needed to Recover Tank 49 for General HLW Storage

The transition of Tank 49 to an air-based mode and subsequent conversion to general use for HLW storage requires these actions:

- Based on continued monitoring of the tank vapor space and waste solution, Tank 49 is projected to return to an air-based mode of operation around August 2000. The air-based mode of operation would require the facility to secure the use of the Nitrogen system and to operate the Tank's Ventilation system at 20.9 % oxygen.
- Complete chemical and accident analyses to bound potential safety issues associated with slurry pump operations in Tank 49.
- Determine the impact of operation of the Tank Slurry Pumps on chemistry, and on the release of benzene.
- Complete chemical and accident analyses to bound the potential issues associated with slurry pump operations in Tank 49.
- Implement physical modifications if required to return Tank 49 to general HLW service.

- Resolution of DNFSB Open Issues for Tank 49

The DNFSB identified several issues related to the ITP process. Because the concentration of NaTPB in Tank 49 waste is slowly decomposing, the applicable issues can be readily resolved to allow Tank 49 to be returned to general use for HLW storage. Of these issues, listed below, the last two (shown in italics) do not apply to Tank 49 since the waste in Tank 49 does not contain insoluble KTPB:

- Either establish a defensible bounding release rate for readily releasable benzene or install features that eliminate the safety concern.
- If avoiding the formation of readily releasable benzene is used as a basis for the Safety Strategy, the slurry pumps should be operated periodically to prevent the formation of a significant benzene layer.
- Demonstrate the ability to predict the threshold concentration of readily releasable benzene in the Tank.
- Reduce the uncertainty about how completely benzene can be depleted during slurry pump operation
- If Tank 49 material is transferred to Tank 50 and subsequently to Z Area, then a defensible peak benzene generation rate must be used as the safety basis for Tank 50 and Z Area.

The Alternative Salt Project and previous DNFSB 96-1 chemistry tests have developed information needed to resolve these open issues for Tank 49 (and Tank 50; see Section 3.1.4 below). The required Chemistry development roadmap to reclaim Tank 49 for HLW storage is outlined in reference 18.

The required design and physical modifications to Tank 49 can be initiated in parallel with the resolution of the DNFSB items. Modifications were made at ITP to isolate Tank 49 from the HLW Storage and Transfer System to prevent the inadvertent transfer of TPB salts from the ITP process to the HLW Tank Farm. Two design changes for Tank 49 (M-DCP-96-081, "Modification to the Inter Area Transfer Line," and P-DCP-96-025, "Modifications to the leak detection box") were issued to provide the separation. A review to confirm slurry pumps and transfer pumps have adequate shielding and pumping capacity for HLW service must also be completed. The modifications that were made to the tank to support inerted operations will be required to remain in place since Tank 49 will be the emergency transfer tank for the material in Tank 48. This includes the Nitrogen system, and vapor space monitoring for benzene and oxygen.

The principal risk associated with Recovery of Tank 49 is that the forecasted TPB intermediates depletion rate and subsequent Benzene Generation Rate do not match the actual sample profiles. This could result in a slip of the forecasted date for the return of Tank 49 to HLW service.

3.1.4 Recovery of Tank 50 for High Level Waste Storage

Tank 50 is presently used as a receipt tank for ETF bottoms, an aqueous waste that is ready for final treatment and disposal as Saltstone. Based on current forecasts, Tank 50 will be filled in FY2004. Z Area must restart in FY2004 to process the waste stored in Tank 50 to prevent shutdown of ETF.

To reclaim Tank 50 for HLW storage, either continuous operation of Z Area is required or alternate storage and treatment is needed to eliminate transfer of ETF bottoms to Tank 50. Construction of a new storage tank for ETF bottoms (the idea selected for the Overall Strategy) has the lowest technical risk. Permitting issues should be minimal, since ETF bottoms contain very low concentrations of radioactive contaminants. In addition, shielding for the Tank 50 valve box, slurry pumps and transfer pumps must be evaluated .

The size of the new tank for ETF bottoms should be optimized to facilitate periodic transfers to the Saltstone Facility. It should also be sized to minimize the potential of an increase in the hazard classification of either ETF or Z area. The tank size could vary from 50,000 to 250,000 gallons and should be based on an optimization study. Construction of a new tank and modifying the transfer line from ETF to Z Area to bypass the Tank 50 valve box would eliminate the interfaces between Solid Waste operations in ETF and Z Area from the HLW Tank Farm. Presently, all transfers from ETF are directed through the Tank 50 valve box. This proposed modification would allow the ETF bottoms to be transferred directly from the ETF evaporator to the new tank and then from the new tank directly to Z Area. By eliminating transfers through the Tank 50 valve box, transfers from ETF to Z Area do not have to be coordinated with HLW operations. This will allow HLW transfers to be made to Tank without impacting ETF or Z Area operations.

The principal risk associated with the Recovery of Tank 50 for HLW storage is that the new tank for ETF bottoms and transfer line modifications will not be completed by FY2004. This would require continued use of the Tank 50 valve box for transfers and continuing (intermittent) operation of Z Area until the changes were complete.

3.1.5 Elimination of DWPF Recycle from the Tank Farm System

By diverting the DWPF recycle stream from the Tank Farm System, both a space gain and processing flexibility advantage can be realized for the Tank Farms. This waste stream can be eliminated by evaporating the unneutralized waste (acid evaporation).

The SM Team selected acid evaporation as the preferred process technology. The Salt Cell in the DWPF was selected for the location of the evaporator in preference to the Late Wash Facility (LWF). The SM Team chose the Salt Cell of the DWPF for three reasons: (1) This location would minimize transfers of radioactive materials outside the DWPF canyon. (2) the incorporation of evaporator bottoms into waste glass would be facilitated. (3) The LWF will likely be used as a pilot facility for the Salt Processing Facility (SPF), thereby avoiding additional cost for the location of a Pilot Plant.

If this evaporator is placed in the Salt Cell, space and equipment for the precipitate hydrolysis unit operations in the DWPF must be added to the ASPF Project. Other locations may provide better operation flexibility, without requiring a major modification to either the ASPF or the DWPF. The SM Team recommends a study be completed to optimize the location of an evaporator to handle DWPF aqueous waste. The principal uncertainty associated with this evaporator is how to handle the Evaporator bottoms. A preliminary review revealed several technical issues that could impact Melter operation, but the SM Team judged all of these issues could be resolved as part of the development of this process.

The project to design the evaporator should start in FY2001 so that it will be operational by FY2005. This time frame includes the location study, design, construction, equipment purchases and testing required to complete the proposed modifications to the DWPF.

There are several risks associated with this Idea. They include resolving design issues, chemical processing concerns, and the requirements to make modifications in an operating facility. The design of the evaporator system will require jumper modifications to be made throughout the DWPF Canyon. These jumpers would need to be capable of transferring aqueous waste to the Salt Cell from both the Melter Cell (Off-Gas Condensate Tank) and the Chemical Process Cell. The Distributive Control system must be modified to delete the Salt Cell operational controls and add in the controls for the new evaporator. Chemical processing concerns are associated with the Evaporator bottoms and the potential for build up of non-volatile salts that will not be compatible with the DWPF process and detrimental to Melter operations.

3.1.6 Reduce Emergency Space to 1300 kgal

Recently, the Liquid Radioactive Waste Handling Facilities Safety Analysis Report (LRWHF SAR), WSRC -SA-33, was issued. The SM Team analyzed the long standing practice of maintaining 1.3 million gallons of emergency space in the H Area Tank Farm and the F Area Tank Farm (2.6 million gallons total). The LRWHF SAR specifies a defense in depth emergency space value for the Tank Farms equal to the largest tank inventory (1.3 million gallons). The use of the Inter-Area Line (IAL) would be required to reduce the Emergency Space to the minimum value of 1.3 million gallons.

This idea states that the minimum emergency space would be reduced incrementally from its current value of 2.6 million gallons, as required, to a level that could eventually drop to the Authorization Basis (AB) “defense- in-depth” value of 1.3 million gallons.

Though a viable idea, this idea should only be implemented near the end of the period before the start of Salt Processing because of the challenges it presents to operation of the Tank Farm. The SM Team identified several conditions that must be assessed before this idea is implemented. A prerequisite for reducing the Emergency Space would be to qualify IAL for emergency transfer readiness. Procedures must be written and upgrades made to the IAL to assure it is available at any time. The new procedures would require regular inspections and maintenance of equipment and instrumentation used for an emergency transfer so that this equipment is always available. The frequency of use of the IAL will increase significantly over the next few years as sludge slurry is sent to ESP and as backlog waste and wash water are sent to the 2F evaporator. Experience gained from these transfers will provide a higher confidence in HLWD’s ability to use the IAL for emergency transfers.

In addition to qualifying the IAL and related procedures for Emergency Transfers, the conditions listed below must be assessed for adverse operational impacts before Emergency Space is reduced. In particular, if conditions related to shutdown of the 2F Evaporator are satisfied, then some of the risks associated with reducing Emergency Space, particular in F Area, are reduced.

- (1) Complete evaporation of backlog waste currently stored in Tanks 30, 32, 35, 39 and 42 (from 40).
- (2) Ensure RHLWE and 2H evaporators are in good operating condition.
- (3) Assess planned processing plans and projected influent streams. If determined to be feasible, place 2F evaporator in warm standby.

- (4) Use available space in the 2F evaporator feed tank, Tank 26, and concentrate receipt tank, Tank 46, for storage of concentrated supernate.
- (5) Continue to assess other possible options for obtaining space.
- (6) Based on planned processing and field conditions at the time, determine the amount of emergency space that should be maintained in each area and recommend the appropriate reduction from the 2.6 million gallons.
- (7) Implement reduction in space reserved for emergency transfers.
- (8) Repeat Steps 6-8, as required to meet space needs, until emergency space has been reduced to the minimum AB requirement of 1.3 million gallons.

3.2 Overall Strategy Implementation

The actions required to implement each idea are shown in Table 3-4. More specific changes needed to implement an idea were developed as part of the detailed costs, given in Reference 13. Further design and related cost estimates must be completed to provide budget-quality costs.

Table 3-4: Actions Required to Implement Strategy

Ideas & Project Descriptions Included in Overall Strategy	Project Schedule		Total Project Cost, M\$
	Start	Finish	
Continue to Evaporate Waste <ul style="list-style-type: none"> No physical modifications Radioactive Startup of the Replacement HLW Evaporator 	NA	NA	NA
Recover & Reuse Tank 49 <ul style="list-style-type: none"> Piping modifications 	2000	2001	2.0
Eliminate DWPF Recycle to HLW Tank Farm by Acid Evaporation of DWPF Recycle in Salt Cell <ul style="list-style-type: none"> Remove existing equipment and install a remotable evaporator Modify piping as needed in DWPF Provide piping from OWST to H-Area Process Sewer Rework DWPF control instrumentation to accommodate evaporator & reprogram PCS software 	2001	2004	28.2
Return Tank 50 to HLW Service By Installing a New Tank for Receipt, Storage and Transfer of ETF Bottoms to Z Area <ul style="list-style-type: none"> Construct new ETF bottoms tank Modify transfer line from ETF to Z Area via the new tank Upgrade shielding on Tank 50 & piping to enable its use in HLW operations 	2001	2004	28.8
Implement Small Volume Gain Initiatives <ul style="list-style-type: none"> Modify piping Upgrade documentation 	2000	2003	1.4
Reduce 2.6 M-gals Emergency Space to 1.3 M-gal (AB Limit) <ul style="list-style-type: none"> Modify piping Install 4 transfer pumps (2 in each Area) Modify infrastructure for inter-area transfer line 	2006	2007	9.6
Total TPC			70.0

- Regulatory Issues

The Overall Strategy requires minimal regulatory changes. The Industrial Waste Water Treatment permit for ETF Bottoms will require changing but this is expected to be a minor action. At the present time, the IWWT Permit defines the path for ETF bottoms to be through Tank 50, where the waste is stored until it can be transferred to Z Area for treatment and disposal. The change proposed will install a new staging tank and modify the transfer line to separate the system from Tank 50.

- Resolution of DNFSB Issues

Several of the ideas require DNFSB review and acceptance that the safety risks are adequately addressed and present minimal risk to the workers and the public. These include: 1) the determination that the benzene potential has been reduced to controllable levels before Tank 49 can be emptied and reclaimed for reuse; 2) flammable gasses (i.e., ammonium nitrate) are prevented or controlled in the acid evaporation of the DWPF recycle; and 3) no undue risks are encountered by implementing the Small Volume Gain Initiatives.

- Implementation Schedule

The projected start date for the implementation of each idea is critical to the Overall Strategy. As shown in Table 3-1, each Idea has a Date that reflects when work to implement an idea must begin to realize the volume gain to meet the ASB. The deferral in reducing Emergency Space until as late as possible is contingent on two key assumptions: (1) ideas are implemented according to the proposed schedule and (2) the SVGI achieve their projected volumes. The TIAS for each Idea and the Small volume gains were calculated on a best estimate basis and are believed to be somewhat optimistic.

Either reducing Emergency Space sooner or adding another Idea not included in the Overall Strategy should be evaluated if any one idea in the Overall Strategy is delayed or the actual space gain is significantly less than projected.

3.3 Strategy Costs

The Life cycle costs (in FY1999 dollars) for various elements of the Overall Strategy are shown in Table 3-4. The incremental difference in costs was determined relative to Planning Case in Revision 10 of the HLW System plan.¹⁹ That is, the cost of a recommended Idea is represented as a delta relative to the costs outlined in the FY1999 Planning Case Budget. Life Cycle Costs were estimated since an idea that offers near-term benefits in cash flow and budget could be vastly over-shadowed by Life Cycle Costs. An example of an idea that has near-term benefits but a high Life Cycle Cost is the Idea of Shutting Down the DWPF. Over the next nine years there would be relatively large savings since there is a reduction in material costs, staffing, and maintenance costs associated with the operation of DWPF. However, from a Life Cycle perspective there is a dramatic impact on cost. The increase in Life Cycle cost is because every year that DWPF is not operating, the HLW system operating life is extended by one year and annually adds \$400 million to cover the HLW Division's operating cost. Table 3-6 summarizes the near term costs for each Idea in the Overall Strategy. The Ideas with a cost increase from the short-term costs to Life Cycle Costs are the Tank 50 ETF bottoms tank and the DWPF Acid Evaporator. These are two new processes that would have increased operations and maintenance costs in the years subsequent to FY2009. The other Ideas are items that have a short-term implementation and operation phase. The Backlog Evaporation, Small Volume Space Gains, and returning Tank 49 to HLW service are all near term items and have the costs associated with it included in the HLW FY99 budget.

Table 3-5: Strategy Life Cycle Costs (Cost in Millions of \$)

Ideas	Total Project Costs	Operating Cost	D&D Costs	Total LCC
Continue to Evaporate Waste	0	8.0	0	8.0
Recover & Reuse Tank 49	2.0	-0.6	0	1.4
Eliminate DWPF Recycle to HLW Tank Farm by Acid Evaporation of DWPF Recycle in Salt Cell	28.2	9.2	0	37.4
Return Tank 50 to HLW Service By Installing New Tank for Staging of ETF Bottoms for Z Area	28.8	-8.0	10	30.8
Implement Small Volume Gain Initiatives	1	1.4	0	2.4
Reduce 2.6 M-gals Emergency Space to 1.3 M-gal (AB Limit)	9.6	0	0	9.6

Table 3-6: Idea Costs Between 2000 and 2009 (Costs in Millions)

Idea	Total Estd. Cost (TEC)	Other Project Costs (OPC)	Total Project Cost (TPC)	Operational Cost	Total Costs
Continue to Evaporate Waste	0	0	0	8.0	8.0
Recover & Reuse Tank 49	1.3	0.7	2.0	-0.6	1.4
Eliminate DWPF Recycle to HLW Tank Farm by Acid Evaporation of DWPF Recycle in Salt Cell	18.0	10.2	28.2	2.4	30.6
Return Tank 50 to HLW Service By Installing New Tank for Staging of ETF Bottoms for Z Area	21.0	7.8	28.8	-8.0	20.8
Implement Small Volume Gain Initiatives	1.0	0.4	1.4	1.0	2.4
Reduce 2.6 M-gals Emergency Space to 1.3 M-gal (AB Limit)	7.0	2.6	9.6	0	9.6

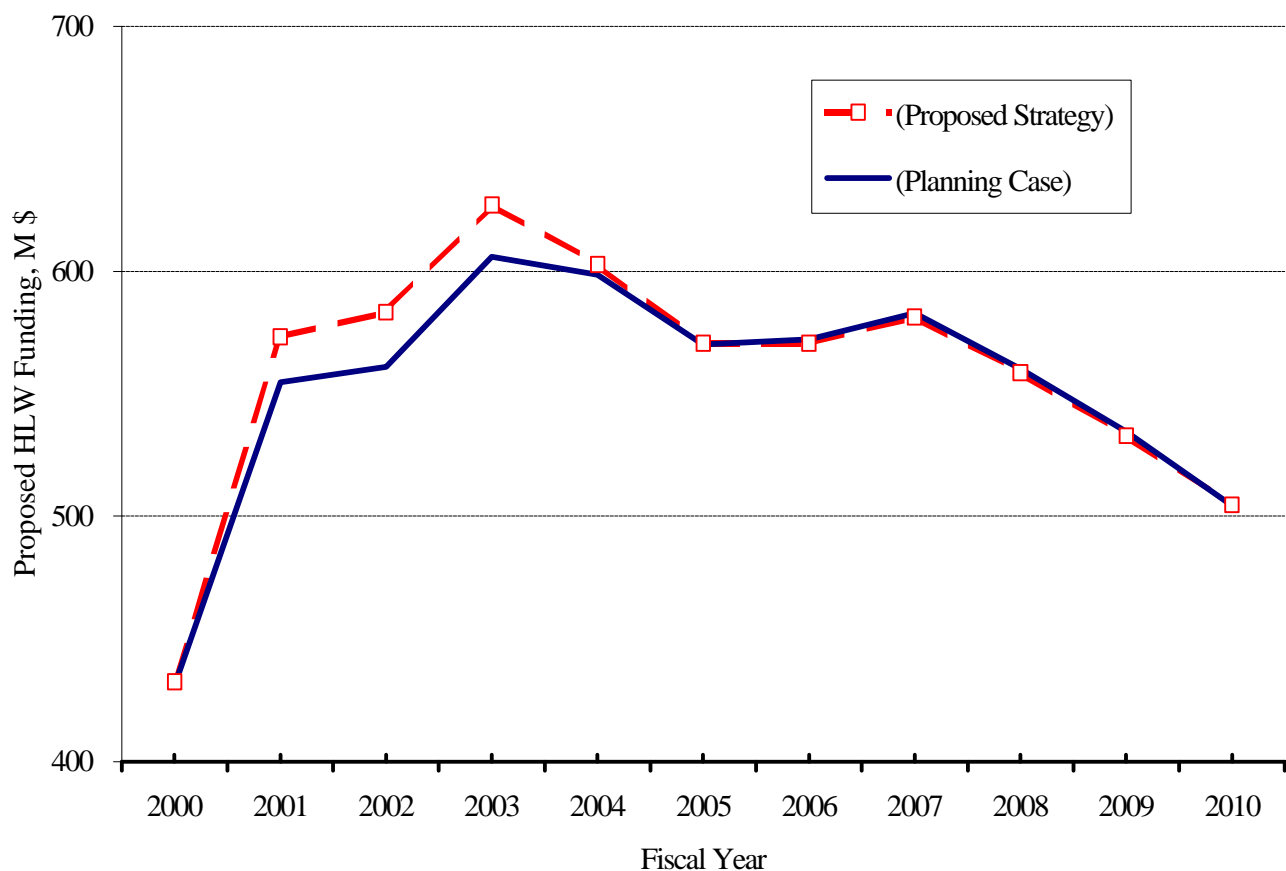
3.4 Strategy Sensitivities

The SM Team Overall Strategy has several sensitivities to cost, schedule and Stakeholder issues. The most sensitive issue in the Overall Strategy is the FY 2000 date associated with the start of the Project for the Proposed Salt Processing Facility. Any delay in the start date for this proposed Project would require a separate major project to be initiated to construct New HLW Tanks. A delay would also likely require Old Tanks to be reused to provide space until either the New Tanks are available for use or the Salt Processing Facility is operational.

The cash flow profile shown in Figure 3-2 shows that the Overall Strategy approximately matches the cash flow profile for the FY1999 planning case. The near-term impact on cash flow and budget constraints is minor compared to the unfavorable impact that a Capital Project such as building New Tanks would impose.

The Overall Strategy is sensitive to new missions and DWPF production rates. The potential for an increase in F and H Canyon production has some impact on the ability of the Overall Strategy to meet the required IAS. Presently the Canyon's effluent comprises approximately 10 percent of the total Waste Management Division waste receipts. Therefore, any new missions must be evaluated for projected waste volume sent to the Tank Farms to establish their potential impact on available space.

DWPF canister production is also a critical parameter. An increase in production rate increases the volume of DWPF recycle waste and also increases the volume of spent wash water from ESP. The logistical difficulties of handling large volumes of dilute waste will likely prevent the Tank Farm and ESP from supporting a sustained canister production rate beyond the level of 200 canisters per year assumed in this study. Significantly higher rates must be deferred until the Salt Processing Facility is operational.



**Figure 3-2: Impact of Overall Strategy on Proposed HLWD Funding
(Basis: Planning Case in Rev. 10 of the HLW System Plan¹⁹)**

4.0 Systems Engineering Process

This section defines processes the SM Team used to objectively and efficiently complete its chartered activities. The process provided steps to develop the relevant information and activities needed for SM Team. The SM Team utilized a SE process. The SE approach is instrumental in managing large and technically complex projects and is recognized by both the DOE and DNFSB as an effective methodology for project development. DOE Order 430.1 (Life Cycle Asset Management LCAM) and the associated Good Practice Guides outline the principles and practices of Systems Engineering, as well as WSRC guidance documents and procedures.

The SE process requires the identification of appropriate personnel and resources to perform mission definition and analysis, functions and requirements analysis, strategy evaluation, risk management, integration & planning, selection, validation, and verification. The Systems Engineering Management Plan (SEMP)³ describes the SE process and methodology. The hierarchical relationship of the SEM³ to other SM Team documents is shown in Figure 4-1.

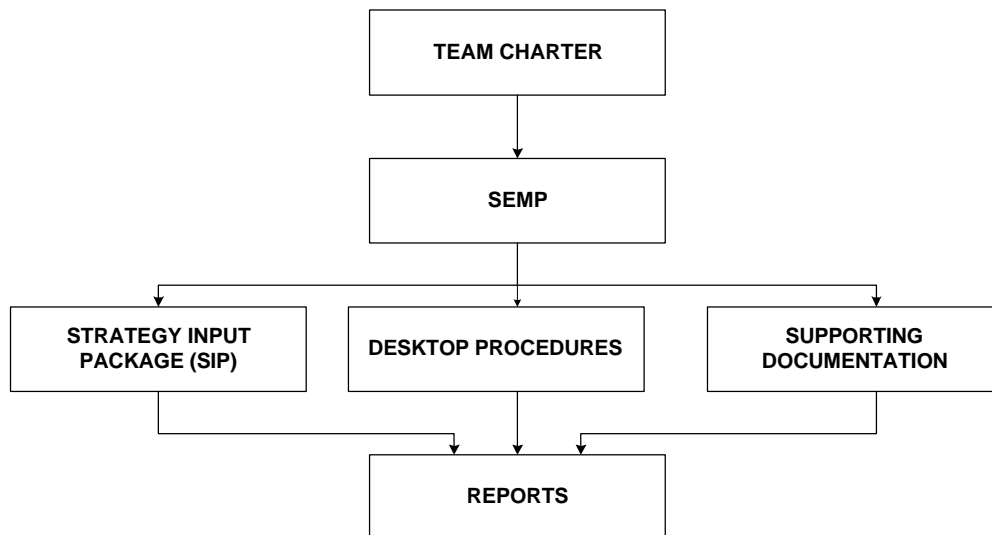


Figure 4-1: Hierarchical Relationship of the SEM to Other SM Team Documents

The process utilized in developing ideas and ultimately a preferred strategy for tank space until 2009 evolved in three phases. These phases are referred to as Identification, Evaluation, and Selection. The major activities and outputs of each phase are illustrated in Figure 4-2.

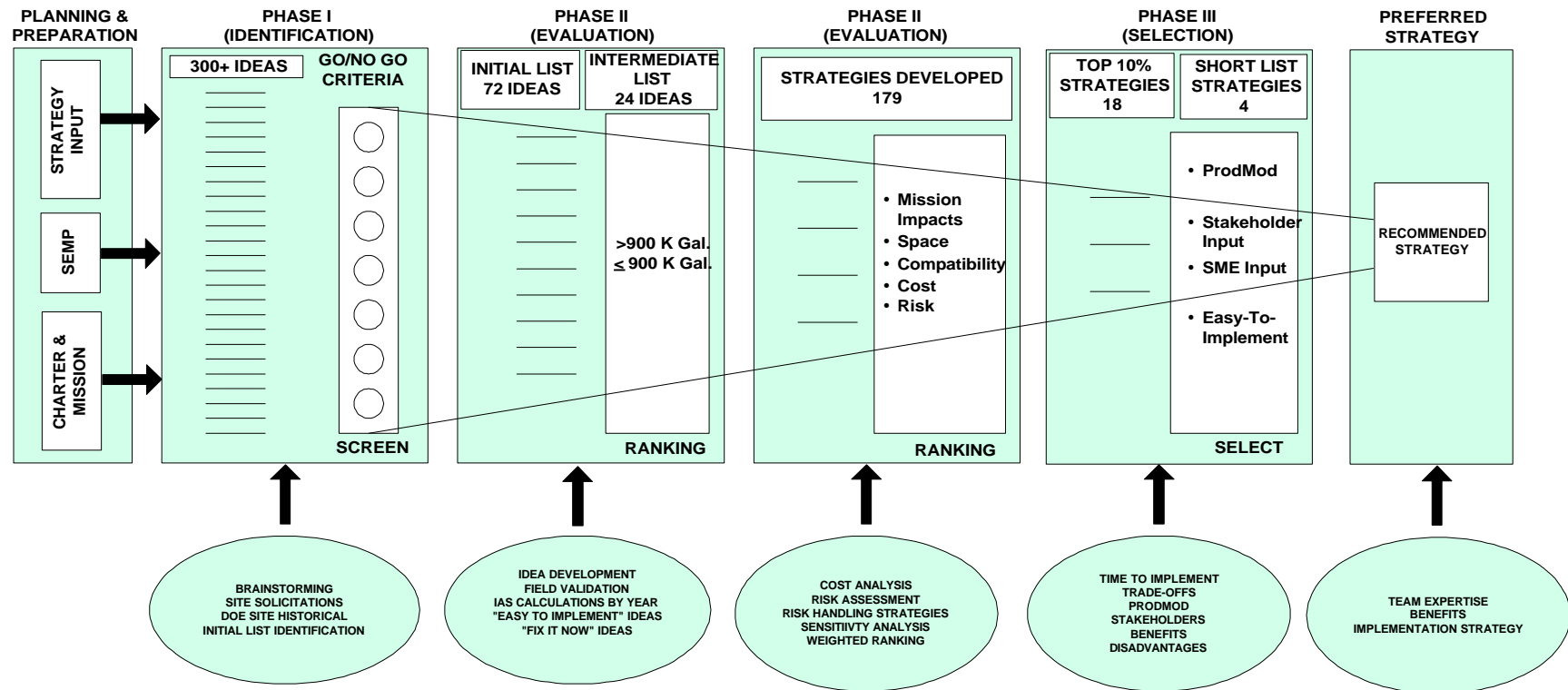


Figure 4-2: System Engineering Process for Strategy Selection

4.1 Identification Phase

During the Identification Phase, the SM Team developed a logic-tied schedule of tasks required to complete the scope of the charter. The principles and practices identified in the SEMP³ were then implemented in the required procedures, position papers, and reports were developed to document the structured controls, inputs, support resources needed, and outputs obtained during the SM Teams activities. This is illustrated in Figure 4-3. This phase focused on applying the SE process in the development of problem definition, top level mission analysis, the necessary and sufficient functions, requirements and interfaces, that a successful Strategy must satisfy, key assumptions, and definitions of terms.

Several systems engineering process tools were used to systematically identify a broad and comprehensive list of diverse ideas and Strategies for subsequent Evaluation and Selection. The methods used included brainstorming by subject matter experts/stakeholders and solicitation of SRS employee input. Models were developed to facilitate brainstorming of ideas. The results of the Identification Phase culminated in the *Initial List*⁸ of ideas, which are discussed in detail in Section 6.0 (Idea Identification).

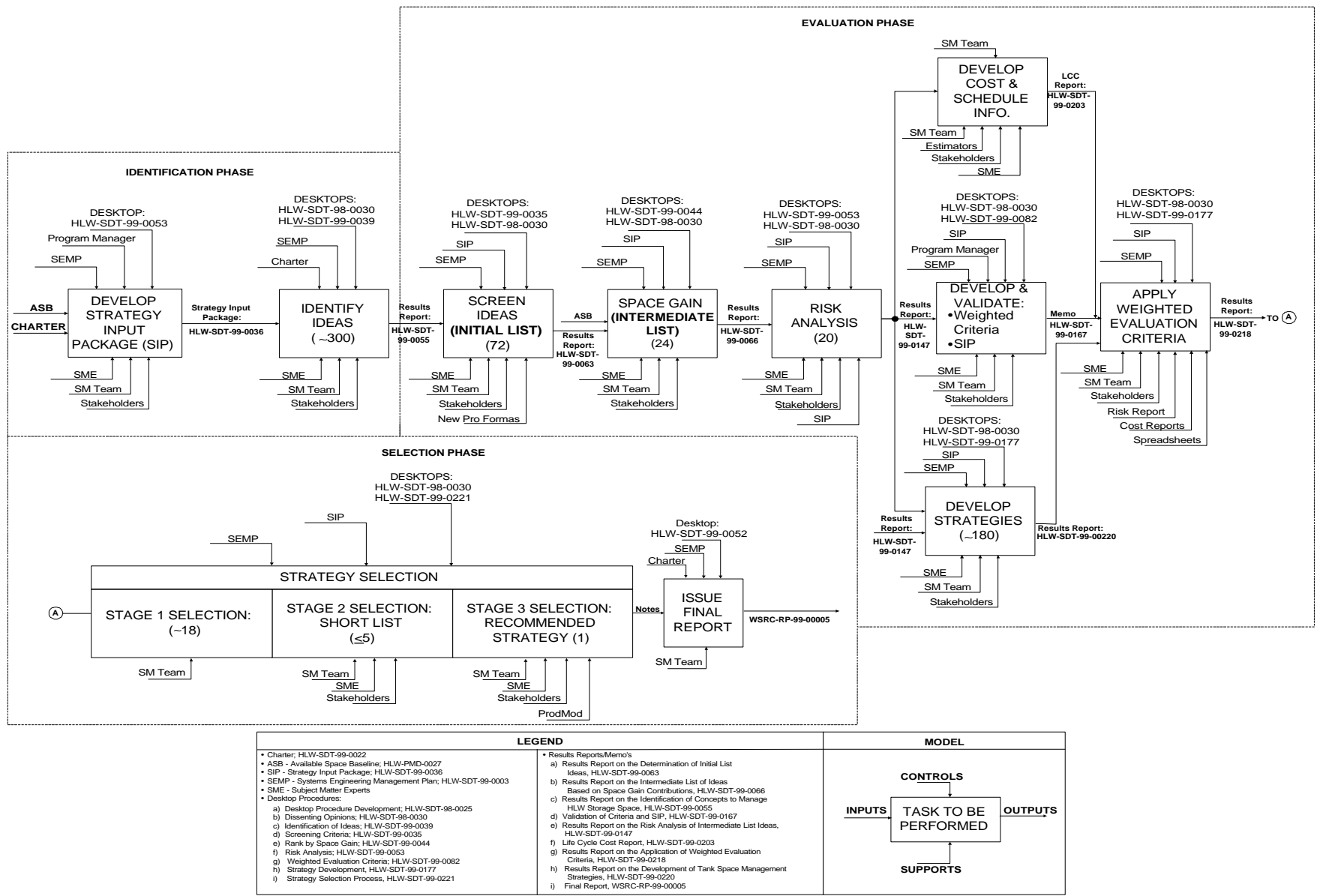


Figure 4-3: HLW Tank Space Management Strategy Development Business Model

4.2 Evaluation Phase

The Evaluation Phase included screening ideas and Strategies, assessing space gain, perform risk analysis, developing cost and schedule information, validation of selection criteria, developing strategies, and applying the weighted evaluation criteria.

High risks were assigned risk handling strategies. In addition, the SM Team conducted a field trip to the AGNS Facility in Barnwell, S.C. for the purpose of validating the risks identified and process applied since this was an “offsite” facility. The details and results of the preliminary risk assessment activities are discussed in Section 8.0 (Strategy Development).

The Evaluation Phase began with a detailed review of the *Initial List*⁸ to further downselect to an *Intermediate List*⁹. This systematic evaluation consisted of defining key evaluation criteria with assigned weights. Each weighted criterion was supplemented by “utility functions”. The utility functions provide a means of consistently evaluating the alternatives against each criterion to yield numerical scores for comparison purposes.

To complete the Evaluation Phase, the SM Team considered the weighted scores, technical information, and risk results to derive the *Short List* of alternatives.

4.3 Selection Phase

The Selection Phase was structured to facilitate the SM Team’s selection of a preferred tank space management Strategy. The results of the ranking by weighted criteria, along with inputs by subject matter experts and stakeholders was augmented by a qualitative evaluation based on SM Team expertise of each of the *Short List* alternatives. The qualitative evaluation considered the strengths and weakness of each Strategy which concluded with the selection of a preferred Strategy. The Selection Phase is discussed in more detail in Section 9.0 (Strategy Down-Selection).

5.0 Strategy Input

This section describes the inputs, controls, supporting resources, and outputs developed by the SM Team for producing the Strategy Input.

Before the SM Team could begin to identify candidate Strategies for HLW tank space management, the requirements and constraints which a successful Strategy must accommodate needed to be defined. This is referred to as “Strategy Input”, and was considered part of the Identification Phase.

The initial step in the process of recommending a HLW tank space management Strategy, was to define the expectations, characteristics, and attributes of a successful Strategy. Strategy Input is the definition of functionality and performance that the recommended Strategy must satisfy, as well as the bases for these expectations.

Figure 5-1 below depicts the model used for development of the Strategy Input Package⁵.

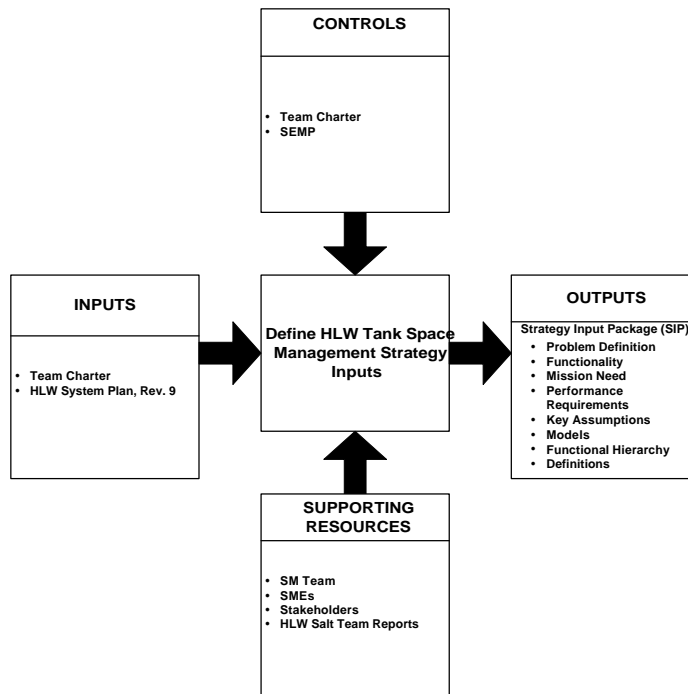


Figure 5-1: Model Depicting Strategy Input Development

5.1 Problem Definition

The SM Team defined the fundamental problem, which the recommended tank space management Strategy must address, as:

“The tank space management strategy in the HLW System Plan (Revision 9)¹ is no longer adequate as a result of the delay in HLW Salt Processing”.

The basis for this definition is the SM Charter².

5.2 Mission Need

The primary mission need to be fulfilled by the recommended HLW tank space management Strategy is defined as:

“Manage HLW storage space to minimize restrictions on

The basis for this resides in the SM Team Charter².

5.3 Key Assumptions

The SM Team found it necessary to identify global assumptions to facilitate the identification, evaluation, and selection of a HLW tanks space management Strategy. As can be expected when searching a long term, multi-faceted solution, such as the task at hand, uncertainties exist. To address these unknowns, the SM Team identified key assumptions. The SM Team made every effort to minimize the number of key assumptions to impose on potential Strategies. The key assumption defined in the SM Team Charter² is:

“No HLW Salt Disposition process is available to begin operation until 2009”.

The additional key assumptions defined by the SM Team are:

- *DOE will remain the primary regulator of HLW at SRS.*
- *Existing and new HLW facilities will continue to be permitted as Industrial Waste Water Facilities.*
- *Current requirements are open to challenge.*
- *Influent streams will be no greater than forecasted.*

- No “emergency” influents from other facilities (e.g., tritiated water from reactor basins) is assumed.
- There will be no tank leaks requiring use of emergency space.
- Trucked waste and 299H waste quantities are considered negligible for strategy development.
- The composition and volumes of existing tank farm inventory is per the Waste Characterization System (WCS), dated 1/22/99.
- Space in tanks 17 & 20 will not be reclaimed because the tanks are closed.

5.4 Functionality

The recommended Strategy must be capable of performing certain necessary and sufficient functions. A function is simply a statement of “what the Strategy must do”. Due to the nature and complexity of managing HLW, the Strategy has several functions which must be accomplished in order to provide safe and cost effective operations within the tank farms. The SM Team developed the functionality in “layers”. The mission need defined in section 5.2 was used as the overall top level function which must be satisfied. Lower levels of functions were also developed. Figure 5-2 illustrates the functional hierarchy at the top two levels.

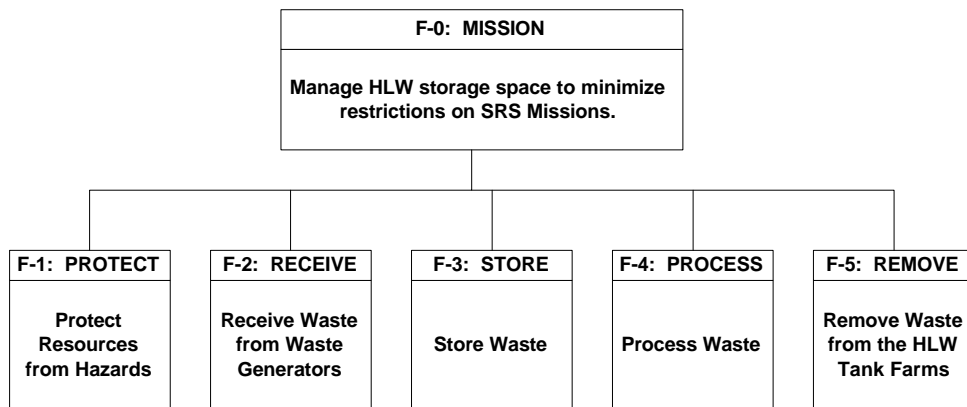


Figure 5-2: HLW Tank Space Management Strategy Top Level Functional Hierarchy

The functional relationship of the top level functions is depicted in Figure 5-3 in a functional flow diagram. This figure indicates the inputs and outputs of each function with respect to the others.

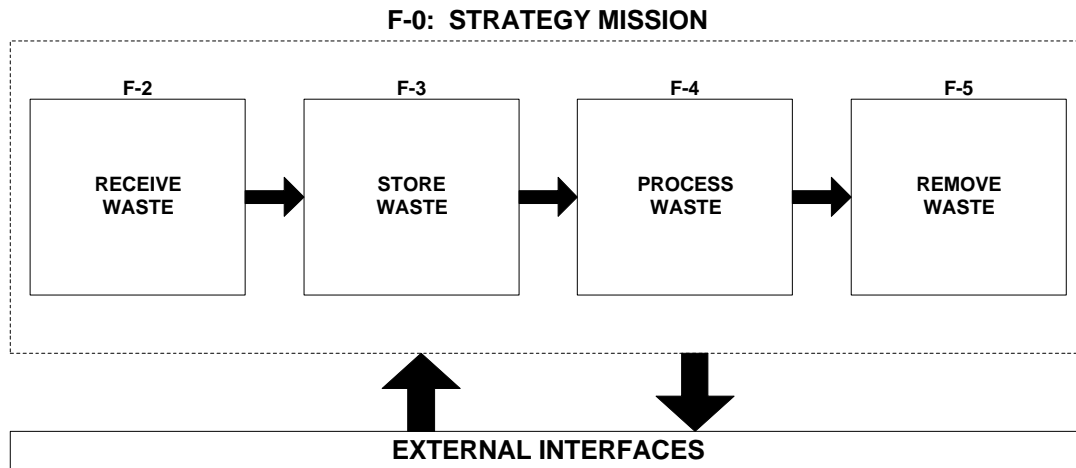
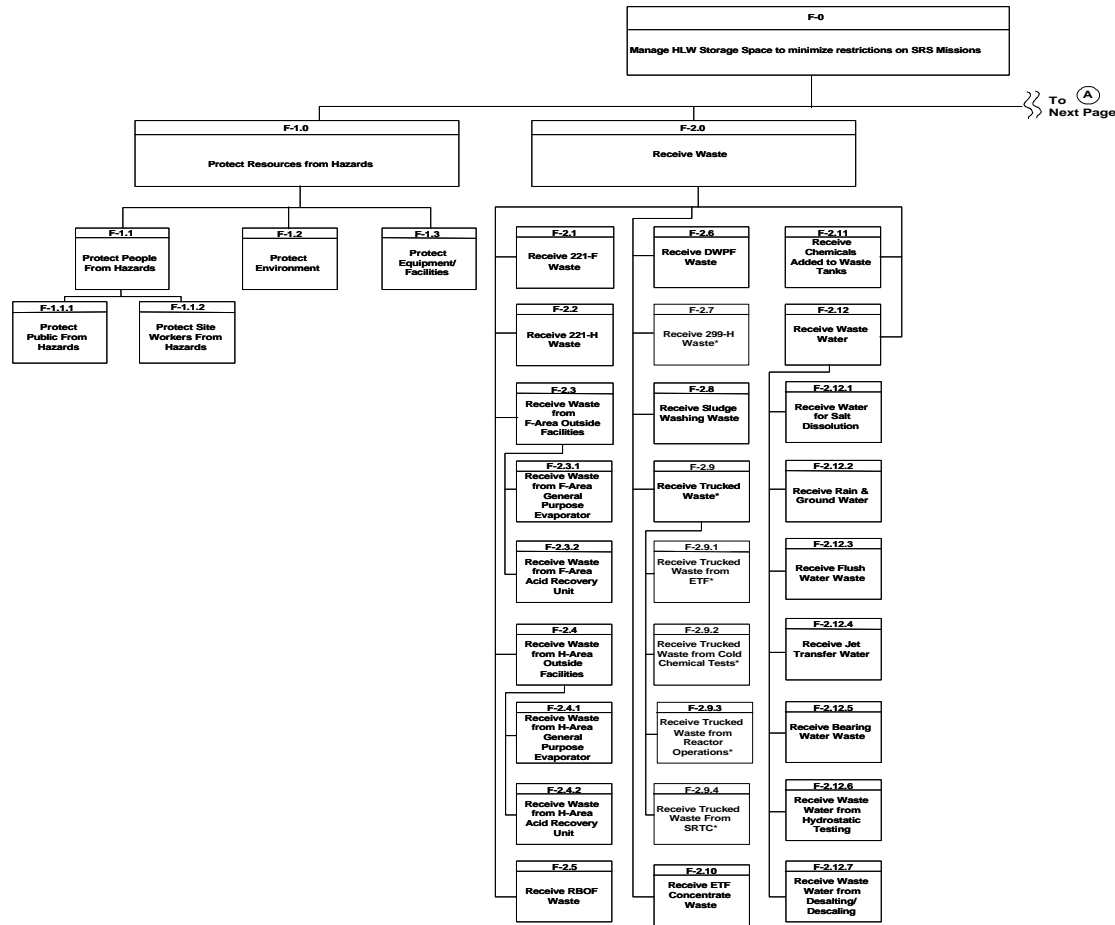


Figure 5-3: HLW Tank Space Management Strategy Functional Flow

The detailed HLW tank space management Strategy functional hierarchy is depicted in Figure 5-4.



*Trucked waste and 299H waste quantities are considered negligible for strategy development.

Figure 5-4: Detailed Functional Hierarchy for HLW Tank Space Management Strategy
(Page 1 of 3)

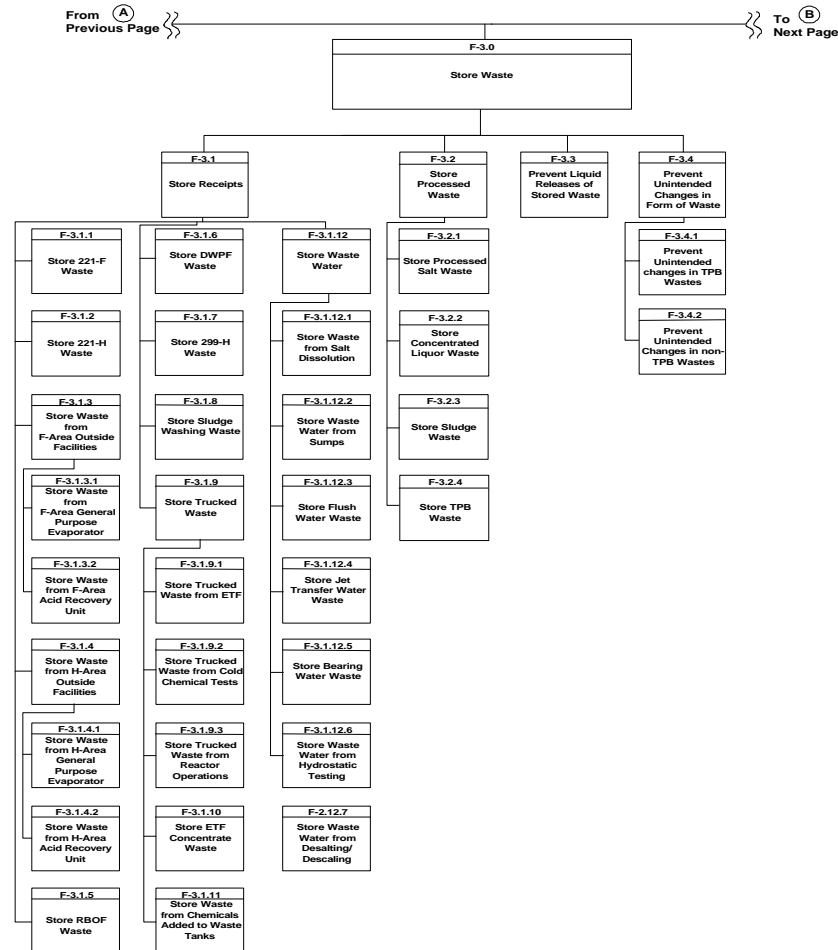


Figure 5-4: Detailed Functional Hierarchy for HLW Tank Space Management Strategy (Cont.)
(Page 2 of 3)

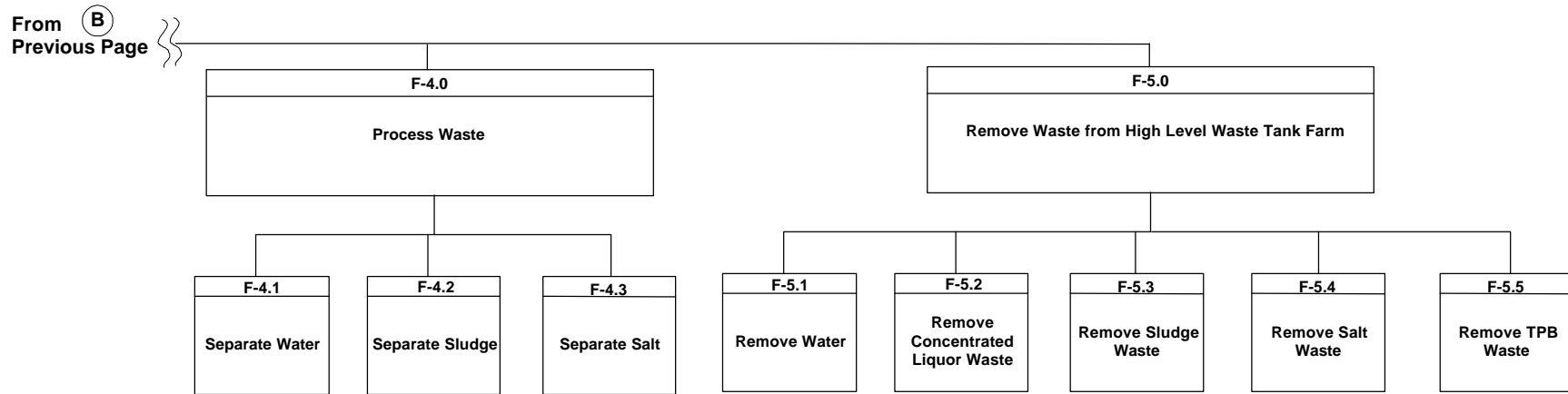


Figure 5-4: Detailed Functional Hierarchy for HLW Tank Space Management Strategy (Cont.)
(Page 3 of 3)

5.5 Requirements

The necessary and sufficient performance requirements were determined and allocated to the appropriate function(s) discussed in Section 5.4. Requirements determining “how well” a function must perform and/or the constraints and interfaces which must be observed. The requirements assigned to the mission level function are provided below. The requirements associated with the second and lower level functions are numerous and are contained in the SIP⁵.

MISSION FUNCTION LEVEL 0

F-0: Manage HLW storage space to minimize restrictions on SRS missions.

MISSION REQUIREMENTS LEVEL 0

The function described in F-0 above:

- R-0-1: Shall meet applicable federal, state, and SRS safety requirements.*
- R-0-2: Shall meet applicable federal, state, and SRS environmental regulations.*
- R-0-3: Shall meet applicable facility Waste Acceptance Requirements.*
- R-0-4: Shall meet applicable Federal Facility Agreements (FFA) and Site Treatment Plan (STP) commitments.*
- R-0-5: Shall accommodate other SRS missions and associated schedules.*
- R-0-6: Shall have the minimum evaluated combination of programmatic and technical risk and life cycle cost.*
- R-0-7: Shall provide emergency tank space per Operational Safety Requirement (OSR 1-1).*
- R-0-8: Shall maintain long term blending strategies for the Small Tank TPB, CST Non-Elutable Ion Exchange, and Direct Disposal in Grout alternatives.*
- R-0-9: Shall only utilize demonstrated technologies.*
- R-0-10: Shall implement proposed changes to existing requirements only after evaluation for stakeholder acceptability.*
- R-0-11: Shall maintain costs within SRS Environmental Management (EM) Funding Profiles.*
- R-0-12: Shall provide storage space for HLW, at least through 2009, to offset the projected deficit in available space.*

5.6 Models

The SM Team developed an administrative solution model and a universal flow sheet model to facilitate physical representations of the functions to be performed. These models are described below.

5.6.1 Administrative Model

The functions to be performed by the recommended HLW tank space management Strategy can only be achieved in four general modes referred to as, 1) decrease or delay incoming; 2) increase outgoing material; 3) compress material; or 4) increase available space. This model is represented in Figure 5-5.

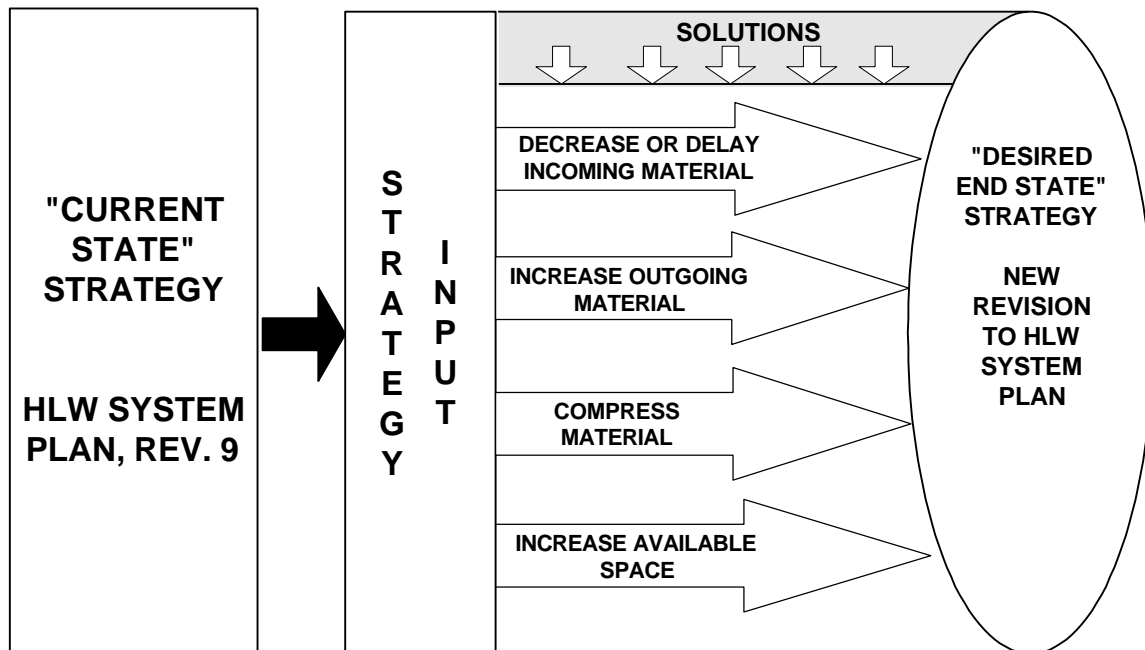


Figure 5-5: HLW Tank Space Management Strategy Administrative Solution Model

5.6.2 Universal Model

The flow of material within, or out of, the HLW system can be described in generic flowpaths as shown in Figure 5-6. Note that the shaded box, which represents the alternative salt disposition proposed project, is not within the chartered activities of the SM Team. It is shown to illustrate the relationship between the SM Team activities and those of the sponsoring HLW Salt Disposition Systems Engineering Team.

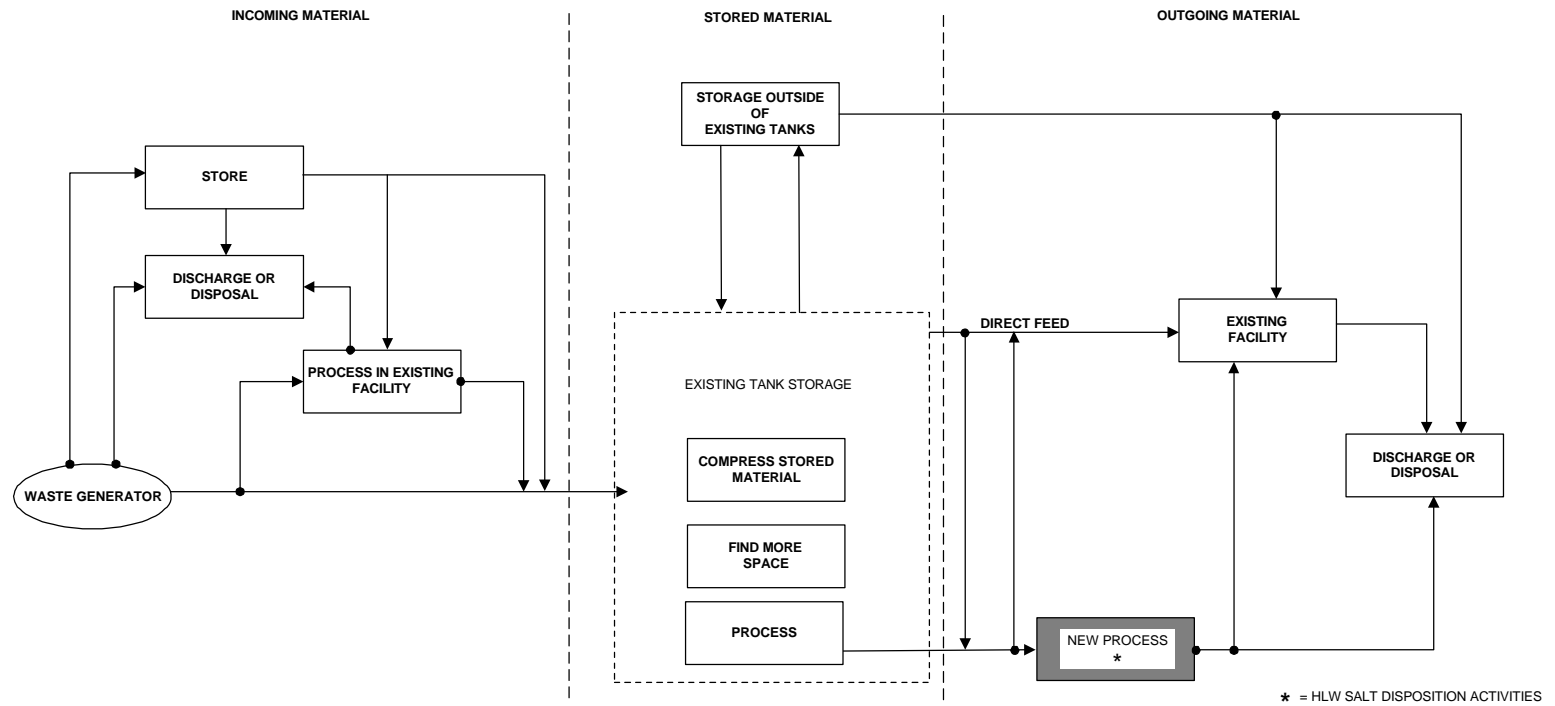


Figure 5-6: HLW Tank Space Management Strategy Universal Flow Sheet Model

5.7 Validation

SM Team methods of validating activities are described below.

5.7.1 During Identification Phase

In accordance with the SM Team Charter, the Program Manager conducted a review of the draft Strategy Input Package⁵ for the purpose of validating that the correct functions, requirements, and key assumptions were defined. Concurrence was obtained.

5.7.2 During Evaluation Phase

The Program Manager conducted a second review of the SIP⁵ to re-validate the inputs, to determine if changes occurred or were necessary. The SIP⁵ was revised to update the space requirements needed each year during the FY-00 to FY-09 time period. The basis for this change to the SIP⁵ is provided in Reference 4. The change increased the ten year space requirement from 5,700,000 gallons to 6,043,000 gallons. Concurrence was obtained from the Program Manager.

6.0 Idea Identification

This section is to present the method and results of the SM Team “idea solicitation” process. This activity is considered part of the Identification Phase.

6.1 Idea Identification Process

The process utilized by the SM Team to identify candidate ideas for evaluation used a dual avenue approach of 1) brainstorming, and, 2) individual contributor inputs.

To facilitate the solicitation process the SM Team distributed a “Briefing Package” of information. This package contained the following information:

- Problem definition
- Critical mission need
- Top level function and requirements
- The administrative model
- A pro-forma sheet with instructions for submitting an idea

The Briefing Package served as both an education/information tool to provide global constraints that ideas must conform and as a vehicle to submit ideas. The ideas submittal form was referred to as a *Pro-Forma Sheet* by the SM Team. “At-Large” distribution of the Briefing Package was made via the Site and Division Chief Engineers Council to organizations in each respective Division.

The SM Team identified subject matter experts and stakeholders to participate in the brainstorming sessions. The SM Team also provided Briefing Packages to the identified participants of the two formal and independent brainstorming sessions held on March 23, 1999. Due to the large number of individuals identified, two separate and formally facilitated sessions were conducted. Each session had a cross-section of participants. Ideas identified were recorded on Pro-Formas for SM Team evaluation.

The SM Team accepted submittals, via Pro-Formas, up until the final selection process was initiated.

6.2 Idea Identification Results

The output⁷ from the process described in 6.1 was approximately 300 ideas (Pro-Formas) being submitted to the SM Team.

The SM Team was receptive to partial solutions which, when appropriately combined, would yield an entire tank space management Strategy for further evaluation. Subsequent sections of this report discuss how this was done and which Strategies evolved.

6.3 Idea Categories

The SM Team reviewed each Pro-Forma in order to understand the idea and request further clarification from the originator, if necessary. Upon completion of this review, ideas were categorized into eight (8) topics based on area of impact or potential implementation. The areas are Administrative, Canyons, Defense Waste Processing Facility (DWPF), Off Site Storage, On site Storage, Alternate Salt Dispositioning, Tank Farms, and Waste Pre-Treatment (WPT). The definition and designated symbol of each category are as follows:

- **Administrative (“A”):**

An idea capable of being implemented by a revision to a procedure, authorization basis documentation waste acceptance criteria, planning documents and planning tools or environmental permits. No physical plant modifications are required.

- **Canyons (“C”):**

An idea that requires a physical, chemical, operating limit, or equipment change in the F and/or H Canyon processes or facilities to allow reduction of Canyon liquid waste.

- **Defense Waste Processing Facility (DWPF) (“D”):**

An idea that requires a physical, chemical or equipment change in the DWPF process or facility. Also includes ideas that require change to the DWPF Waste Compliance Plan (WCP).

- **Off Site Storage (“F”):**

An idea to use off site facilities for processing and storage of waste.

- **On Site Storage (“N”):**

An idea to use facilities other than HLW facilities for processing and storage of waste.

- **Alternative Salt (Alt Salt) (“S”):**

An idea associated with the processing salt solution. Utilizing one of the selected alternatives or the proposed pilot plant.

- **Tank Farms (“T”):**

An idea that requires a physical, chemical or equipment change in the F and/or H Tank Farm processes or facilities. Also includes ideas that require change to the Tank Farm AB and Waste Acceptance criteria.

- **Waste Pre-Treatment (WPT) (“W”):**

An idea related to the recovery of WPT processing tanks and supporting facilities for waste storage; associated with processing salt through some variation of the existing In-Tank Precipitation (ITP); and/or require a physical, chemical or equipment change to the Extended Sludge Process (ESP) facilities.

A listing of ideas submitted and the categories to which they were assigned exists in Reference 7.

6.4 Idea Screening

The SM Team screened each of the ideas to determine if there were any which could not meet certain “Go/No Go” criteria. The Strategy Input Package⁵ and Charter² were reviewed to establish these criteria. The criteria selected are listed below. The parenthetical information indicates the source of the criterion.

- Decreases incoming material to the tank farms, increases outgoing material to the tank farms, compresses material within the tank farms, increases available storage space for HLW, or any combination of these four possibilities (SIP: Administrative Model).
- Demonstrated (proven) Technology (SIP Requirement: R-0-9).

- Assures long-term blend Strategies for the Small Tank Tetraphenylborate (TPB), Crystalline Silicotitanate (CST) Non-Elutable Ion Exchange, and Direct Disposal in Grout alternatives are not compromised (SIP Requirement: R-0-8).
- Risks to the public, worker, and/or environment are maintained within acceptable limits (SIP: Key Assumption).
- NRC licensing not required (SIP: Key Assumption).
- Does not require the use of tanks 17 and 20 (SIP: Key Assumption).

An idea failing to pass any one of the criterion was considered unacceptable, documented as to reason for failure, and eliminated from further consideration. If insufficient information existed to evaluate the idea against the screening criteria, the ideas were carried forward as acceptable.

6.5 *Initial List of Ideas*

The final step of the idea Identification Phase was the generation of the “*Initial List*”⁸ of ideas. To establish this list, the ideas within each category, which passed the “Go/No Go” screening criteria⁶ were reviewed for similarity, redundancy, and/or duplicity. Where similarities exist, the ideas selected for the “*Initial List*”⁸ were chosen based on the most representative and/or inclusiveness of the idea with respect to other ideas in the same category. This step was intended to define obvious combinations. No attempt to “force” the inclusion of one idea into another was made.

The “*Initial List*” contains seventy-two (72) ideas that were carried forward for more in-depth evaluation by the SM Team. A detailed listing of the “*Initial List*” is contained in Reference 8.

It is to be noted that each “*Initial List*” idea is considered technically implementable. No significant scientific issues or uncertainties were identified. Some potential engineering studies to address scaling and sizing may be required to further define an idea, but no technical “show stoppers” exist.

6.6 *Ideas not on ‘Initial List’*

There are two reasons why an idea does not appear on the “*Initial List*”. First, the idea failed the Go/No Go screening criteria, or secondly, the idea is represented by one or more of the ideas that did make the “*Initial List*”. Reference 8 provides details of the SM Team disposition of ideas at this stage.

7.0 Evaluation of Ideas

The purpose of this section is to describe the Evaluation Phase, which began with the “*Initial List*”⁸ of seventy-two (72) ideas (from Section 6.0), subsequently narrowed to the “*Intermediate List*”⁹ of twenty-four (24) ideas, and culminated in a risk analysis of the “*Intermediate List*”⁹ of ideas.

7.1 Space Gain Ranking

The Evaluation Phase commenced with the development of calculations to determine the Ten-Year Increase in Available Space (TIAS) gain for each of the “*Initial List*” ideas. The TIAS values, as measured in K-gallons, were determined by implementation of the desktop procedure⁶ entitled, “Dispositioning the “*Initial List*” Ideas Based on Available Space Contributions”.

The method used to determine the Ten-Year Increase in Available Space is depicted in Figure 7-1. The definitions relevant to this process are described in the glossary (Section 10). The calculations were documented⁹ along with the necessary assumptions and appropriate comments to provide clarification.

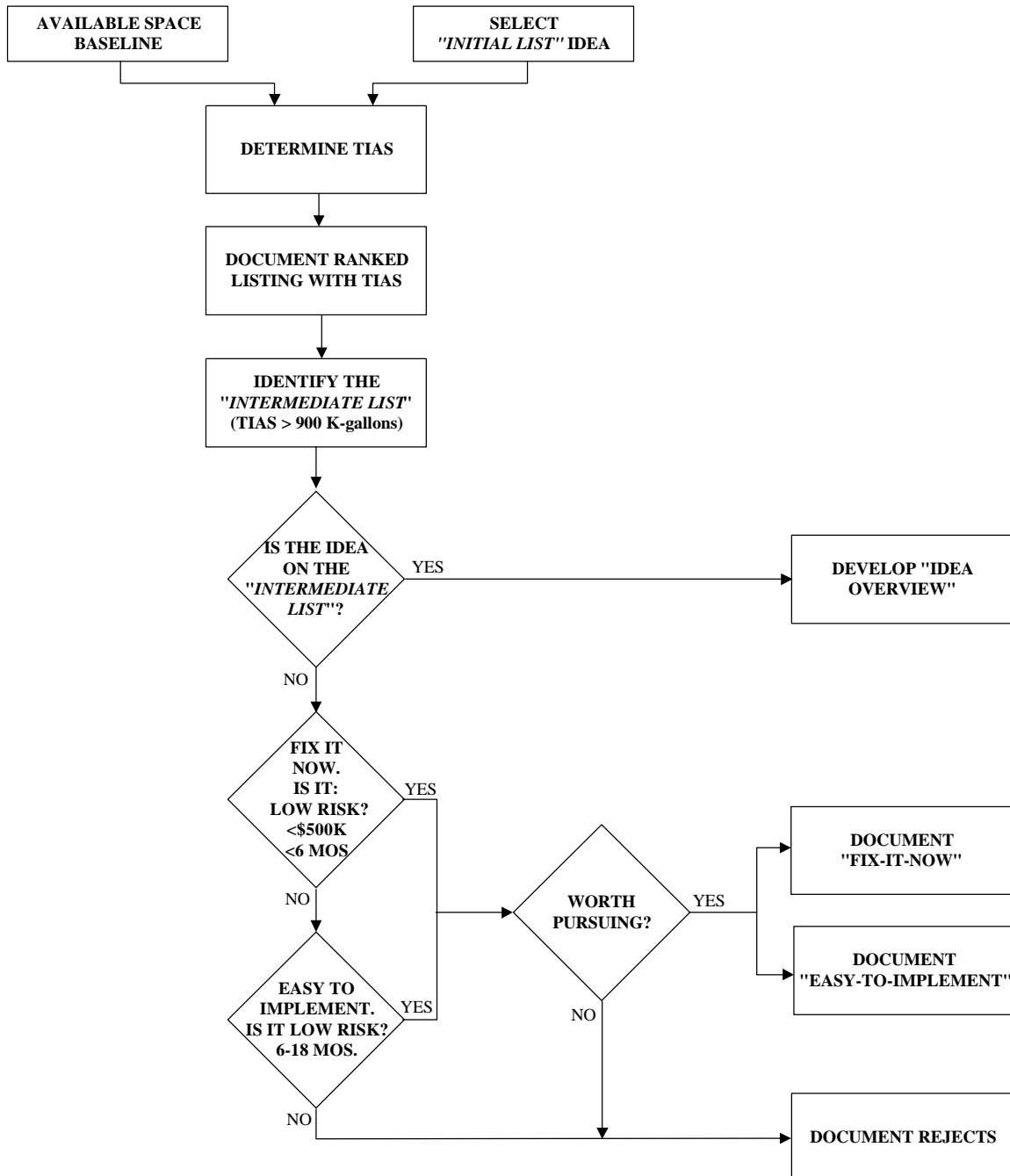


Figure 7-1: TIAS Ranking Process for *Initial List* Ideas

Table 7-1 provides a numerical ranking of the seventy-two (72) “*Initial List*” ideas based on TIAS values (largest to smallest).

Table 7-1: Ranking *Initial List* Based on TIAS
(Listed in order of decreasing TIAS)

INITIAL LIST IDEA NO.	INITIAL LIST IDEA SUMMARY	TIAS SCENARIO (X those applicable)				TIAS (UNITS = K GALLONS)	INTERMEDIATE LIST IDEA NUMBER
		INCREASES OUTGOING	NEW STORAGE SPACE	COMPRESSES EXISTING HLW	REDUCES INFLUENTS		
A-41	Do everything listed in Rev. 10 of the System Plan.	X	X			7,566	IL-2
T-30	Allow use of Tanks 4 through 8 for salt solution storage after sludge is removed.		X			3,750	IL-3
S-11	Dissolve salt cake with low Ci concentration of Cs-137, e.g., Tank 38 salt. Do MST strike to remove Sr and alpha. Send to Saltstone. Will probably require changing Saltstone WAC, perhaps to Class B.	X				3,430	IL-6
W-37	By increasing the shielding in Z-Area, Saltstone with higher concentrations of Cs-137 can be disposed up to the Class A limit. If permits are modified to allow Class C disposal, MST to remove alpha would be minimized.	X				3,430	IL-7
A-40	Shutdown DWPF.				X	3,393	IL-5
T – 56	Build new waste tanks to meet space needs.		X			3,200	IL-1
A-32	Use Type I Tanks 4 - 8 as emergency spare space so that all Type III tanks can be used for storing waste.		X			2,000	IL-4

INITIAL LIST IDEA NO.	INITIAL LIST IDEA SUMMARY	TIAS SCENARIO (X those applicable)				TIAS (UNITS = K GALLONS)	INTERMEDIATE LIST IDEA NUMBER
		INCREASES OUTGOING	NEW STORAGE SPACE	COMPRESSES EXISTING HLW	REDUCES INFLUENTS		
N-11	Use reactor drain tanks or other tanks in the reactors to store low level waste. Possible on-site storage.		X			2,000	IL-8
T-3	Evaporate backlog waste. Transfer salt solution in these tanks to existing evaporator system or the RHLWE system to evaporate and regain space. Address tritium limits.	X				1,526	IL-10
D-6	Send DWPF recycle directly to Saltstone.				X	1,372	IL-13
T-57	Provide separate emergency storage space for existing HLW inventory. Buy new tanks to provide this emergency storage.		X			1,323	IL-16
A-38	Use space in both areas to meet single TSR emergency space requirements. Also consider crediting pump tank volumes.		X			1,300	IL-17
S-14	Send ETF bottoms directly to Saltstone and use Tank 50 for waste storage.		X			1,200	IL-18
F-10	Chem Nuclear in Barnwell has a pilot scale facility that evaporates aqueous waste to dryness and places the waste in an NRC-Approved container qualified for near-surface LLW disposal. Dry salt from this operation could be stored or disposed in either E-Area or Z-Area.	X				1,200	IL-20

INITIAL LIST IDEA NO.	INITIAL LIST IDEA SUMMARY	TIAS SCENARIO (X those applicable)				TIAS (UNITS = K GALLONS)	INTERMEDIATE LIST IDEA NUMBER
		INCREASES OUTGOING	NEW STORAGE SPACE	COMPRESSES EXISTING HLW	REDUCES INFLUENTS		
W-11	Recover Tank 50 for Tank Farm storage. For example, use the organic waste storage tank or build a hold tank with the capacity to store about one month of ETF evaporator concentrate. Alternatively, use Tank IV tanks to store the bottoms or grout ETF bottoms in 55-gallon drums.		X			1,200	IL-21
N-19	Use Tanks from Reactors Areas for ETF Bottoms (HLW to Tank 50)		X			1,200	IL-69
T-48	Reduce DWPF production to 125 cans/year.		X			1200	IL-72
D-12	Split DWPF water into separate streams (chemical Cell and Melter Off Gas). Evaluate each stream for Saltstone and ETF; treat, if necessary to meet WACS.					1,176	IL-11
D-5	Treat DWPF Recycle using CST (or other technology) and send to Saltstone.				X	1,176	IL-12
D-13	Install evaporator for DWPF Recycle, route bottoms to DWPF, Overheads to ETF.				X	1,176	IL-14
D-37	Divert recycle to a separate treatment process somewhere else based on CST IX and then send decontaminated waste to Z-Area for disposal as saltstone.				X	1,176	IL-15
D-27	Reduce DWPF production to 125 cans/year.				X	1,175	IL-24

INITIAL LIST IDEA NO.	INITIAL LIST IDEA SUMMARY	TIAS SCENARIO (X those applicable)				TIAS (UNITS = K GALLONS)	INTERMEDIATE LIST IDEA NUMBER
		INCREASES OUTGOING	NEW STORAGE SPACE	COMPRESSES EXISTING HLW	REDUCES INFLUENTS		
W-4	Decompose all TPB materials in Tank 49 (perhaps simply by waiting a year or so), then transfer to Tank 50 to combine with ETF bottoms, or transfer to Tank 48. Return Tank 49 to HLW storage use.		X			1,060	IL-22
A-34	Make Tank 48 and 49 emergency spare tanks for Tank Farm, eliminating the need to reserve space in other HLW tanks.		X			960	IL-9
D-3	Send more supernate to DWPF by revising glass quality specifications to allow higher sodium levels in sludge so less washing is needed.	X				640	N/A
A-2	Increase specific gravity of concentrate from 1.45 to 1.60 during evaporator operation.	X				640	N/A
F-1	One or two tanks at AGNS are designed for HLW storage. Use them in place by transporting waste to them or move the waste tanks to SRS for use.		X			600	N/A
W-29	Use waste with high hydroxide concentration for aluminum dissolution rather than fresh sodium hydroxide.				X	585	N/A
A-37	Use ESP tanks for emergency spares.		X			568	N/A
A-18	Revise the Tank Farm WAC to eliminate practices that affect space negatively, especially excess caustic additions and dilution required in canyon.				X	480	N/A

INITIAL LIST IDEA NO.	INITIAL LIST IDEA SUMMARY	TIAS SCENARIO (X those applicable)				TIAS (UNITS = K GALLONS)	INTERMEDIATE LIST IDEA NUMBER
		INCREASES OUTGOING	NEW STORAGE SPACE	COMPRESSES EXISTING HLW	REDUCES INFLUENTS		
T-1	Develop a small evaporator (1-5) gpm that can be mounted in a riser. Install on tanks that have partially concentrate supernate. Concentrate supernate to 15-20 M Na. Alternative, use natural evaporation or find other processing equipment.	X				450	N/A
T-87	Reclaim Tanks 43 & 26 for concentrate storage by shutting down 2F & 2H Evaporators.		X			400	N/A
A-27	Reschedule sludge processing to process only F Tank Farm sludge, which does not require aluminum dissolution.				X	325	N/A
D-26	Update earlier DWPF water study (WSRC-TR-93-0677, Dec. 20, 1993). Develop and fund a program to implement.				X	315	N/A
D-40	Process waste in tanks 48 and 49 through the DWPF salt cell. Provides a way to remove organic waste from these tanks to they can be used for storage of concentrated supernate and/or salt cake.	X				300	N/A
W-40	Change waste removal priorities so that sludge from Type III and IIIA tanks is sent to DWPF first. Leave sludge in Type I, II, and IV tanks until salt disposition process is operating.	X				300	N/A
S-2	Build and operate the alternative salt pilot plant to reclaim small amounts of space until Alt Salt Plant is built.	X				280	N/A

INITIAL LIST IDEA NO.	INITIAL LIST IDEA SUMMARY	TIAS SCENARIO (X those applicable)				TIAS (UNITS = K GALLONS)	INTERMEDIATE LIST IDEA NUMBER
		INCREASES OUTGOING	NEW STORAGE SPACE	COMPRESSES EXISTING HLW	REDUCES INFLUENTS		
T-13	Add telescoping transfer jets to selected tanks. Telescoping transfer jets allow feed to be drawn from layers in tanks to promote maximum space regain, evaporator efficiency and minimize salt drop out as salt cake.	X				279	N/A
T-37	Use the Type IV tanks to store wastes with low activity, such as the DWPF recycle.		X			260	N/A
C-14	Place SS tanks in unused portions of canyons. Store acid byproduct solutions until salt processing begins. Alternatively, shut down canyon processes or treat acid waste to enable diversion to other facilities.		X		X	250	N/A
A-8	Increase operating limit in Type III/IIIA tanks to tank penetration. For most tanks, this is an increase of 3" in operating limit.		X			242	N/A
T-46	Tanks 18 and 19 are not closed and could be used for LLW storage.		X			180	N/A
D-19	During melter idling, flow to both SASs in the DWPF Melter Off Gas system should be stopped after the cold cap has disappeared (~6 hr.).				X	146	N/A
W-41	Send just enough salt to DWPF to make up for lack of precipitate perhaps by washing sludge less. Do not increase canister production or change glass quality specifications.	X				97	N/A

INITIAL LIST IDEA NO.	INITIAL LIST IDEA SUMMARY	TIAS SCENARIO (X those applicable)				TIAS (UNITS = K GALLONS)	INTERMEDIATE LIST IDEA NUMBER
		INCREASES OUTGOING	NEW STORAGE SPACE	COMPRESSES EXISTING HLW	REDUCES INFLUENTS		
D-46	Melter salt waste into sludge stream being processed in DWPF.	X				97	N/A
D-43	Change the amount of frit and water used to decontaminate canisters. Use the amount needed for the actual Ci content of the feed rather than the design values.				X	50	N/A
D-28	Current RCT transfer operations requires three batch transfers to the Recycle Waste Tank (RWT) in the LPPP. By bypassing the RWT in the LPPP and transferring directly to the Tank Farm, two RCT pump primes in the DWPF are eliminated (~120 gal/RCT batch).				X	44	N/A
D-30	SMECT scrubber pump has plugged J-Tube which prevents priming the pump at low tank levels, so several thousand gallons of water must be added to restart pump (4 to 6 times a year).				X	38	N/A
W-33	Optimize sludge washing to reduce the amount of wash water. Develop detailed fragnets and assumptions for A1 dissolution and washing.				X	21	N/A
D-39	Use DWPF recycle for rewetting dry sludge rather than inhibited water. The recycle waste is already inhibited and avoids adding salt in a "new" inhibited water.				X	14	N/A

INITIAL LIST IDEA NO.	INITIAL LIST IDEA SUMMARY	TIAS SCENARIO (X those applicable)				TIAS (UNITS = K GALLONS)	INTERMEDIATE LIST IDEA NUMBER
		INCREASES OUTGOING	NEW STORAGE SPACE	COMPRESSES EXISTING HLW	REDUCES INFLUENTS		
T-58	Provide emergency storage space by placing tanks within the old evaporator cell.		X			7	N/A
D-29	Provide a jumper to route DWPF recycle waste to Tank 51 or Tank 40 flush connections to use the dilute DWPF recycled waste for flushing instead of clean inhibited water. Alternatively, flush with well water (no inhibitors).				X	3	N/A
T-24	Flush water can be minimized by making it an optimization criteria for planning a transfer.				X	1	N/A
D-32	Present DWPF treatment for HEPA's is based on caustic dissolution of fiberglass filters that is then combined with other recycle waste. By converting to acid decontamination and disposal as solid waste, salt generated from HEPA treatment/disposal is never generated.				X	1	N/A
C-20	Reduce NMSS waste as much as possible without curtailing missions, e.g., reduce PVV flushes, increase acid stripping, use HAN, eliminate or decrease poisons, use electrolytic dissolver to destroy nitrate.				X	1	N/A
A-14	Improve WCS database to 1) ensure information is update, 2) better waste characterization. Would improve our ability to confidently forecast.					<1	N/A

INITIAL LIST IDEA NO.	INITIAL LIST IDEA SUMMARY	TIAS SCENARIO (X those applicable)				TIAS (UNITS = K GALLONS)	INTERMEDIATE LIST IDEA NUMBER
		INCREASES OUTGOING	NEW STORAGE SPACE	COMPRESSES EXISTING HLW	REDUCES INFLUENTS		
A-13	Confirm space gain factors to improve our ability to confidently plan future Tank Farm space.					<1	N/A
T-9	Determine best way to operate evaporators to maximize space gain, e.g., make liquor where appropriate rather than salt cake, continuous vs. batch processing, recycle timing.					<1	N/A
A-12	Develop better performance indicators for material movement so that decision makers are attuned to when something will impact Tank Farm space.					<1	N/A
T-65	Remove cesium from waste by adding zeolite to Tank 42, send cleaned supernate to Saltstone.	X				0	N/A
A-11	Revisit Harry Harmon task team initiative. Boundary conditions were well defined and evaluated to better understand process viabilities (Contact Jerry Morin).					0	N/A
T-36	Eliminate FFA restrictions on use of Type I, II, IV by modifying the tanks (liners, under liner leak detection).					0	N/A
A-23	Improve system plan and model to remove fat (conservatism) by using root-mean-sum-of-squares methodology to obtain more realistic projections					0	N/A
A-16	Establish financial incentives to minimize influents, or establish volume limits for accepted waste.					0	N/A

INITIAL LIST IDEA NO.	INITIAL LIST IDEA SUMMARY	TIAS SCENARIO (X those applicable)				TIAS (UNITS = K GALLONS)	INTERMEDIATE LIST IDEA NUMBER
		INCREASES OUTGOING	NEW STORAGE SPACE	COMPRESSES EXISTING HLW	REDUCES INFLUENTS		
A-1	Leave salt in old style tanks until disposition process needs feed (leave salt in tanks 1, 2, 3, 9). Requires modifications to the FFA and FFCA Site Treatment Plan.					0	N/A
S-5	Send salt solution that will meet Saltstone disposal requirements without further treatment to Z-Area for disposal as saltstone. Blend ETF bottoms, if necessary.					0	N/A
T-12	Leaking coils can consume valuable space. Early detection would minimize the affect on available space. Also consider improving tank level indicators.				X	0	N/A
T-23	Limit slurry pump operation to reduce seal leakage.				X	0	N/A
A-19	Establish performance indicators on chemical waste generators overtime to improve basis for forecasts and identifying places to reduce Salt Waste.					0	N/A
W-45	Build ESP Facility (HLW to Tank 40 & 51)		X			0	N/A
A-25	Privatize the problem, allowing private capital (borrowed, if needed) to be used without exceeding federal budget limits.					0	N/A
A-29	Delay tank closure to keep space available					0	N/A

7.2 Intermediate List Ideas

The SM Team defined an *Intermediate List*⁹ idea as one having ≥ 900 K-gal. of TIAS. The bases for this cut-off level are as follows:

- 900K gal. is a close approximation to a Type I, II, III, IV HLW Tank.
- This is the TIAS value below which the smaller space gain ideas referred to as “Fix-It-Now” and “Easy-To-Implement” ideas begin to appear and will be evaluated in parallel to the major space gaining ideas.
- The requirement (Reference 5) to obtain the lost Tank 40 one million gallon space as soon as possible.
- The slope of the space demand curve in Reference 5 averages about 800K gallons per year.

A comparison of the *Intermediate List*⁹ to the *Initial List*⁸, based on TIAS values, is shown in Figure 7-2.

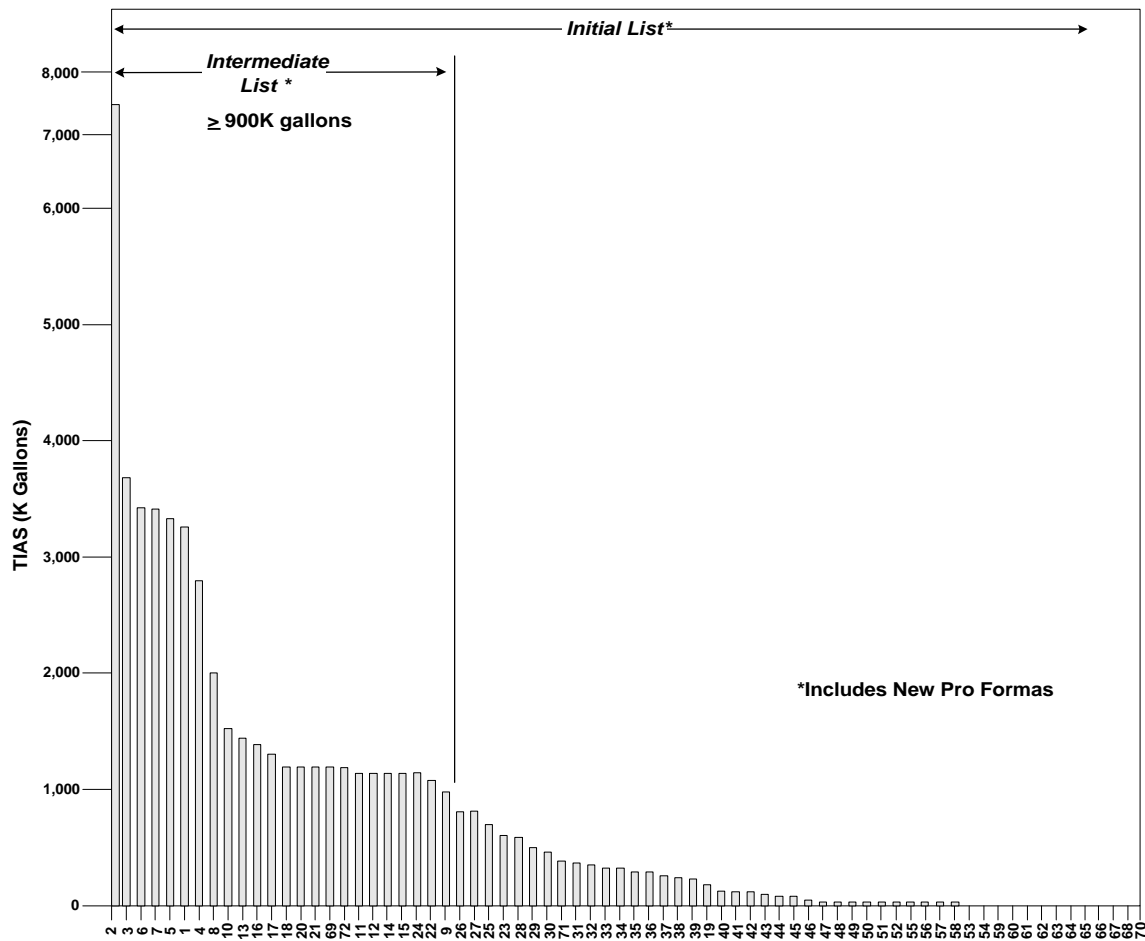


Figure 7-2: *Intermediate List* versus *Initial List* Ranking Profile

A cross reference between the *Intermediate List* idea number and the original *Initial List* idea number is shown in Table 7-2.

During this phase, *Intermediate List* idea IL-2, “HLW System Plan, Rev. 10” was identified as a stand-alone Strategy consisting of several other *Intermediate List* ideas, i.e., IL-10, 22, 4, and 18. For the purpose of this report, IL-2 is evaluated as a Strategy and not as an idea.

Table 7-2: Summary of *Intermediate List* Ideas Based on TIAS Values (High to Low)

<i>Intermediate List</i> Number	<i>Initial List</i> Number	<i>Intermediate List</i> Idea Title	TIAS (K Gal)
IL-2	A-41	HLW System Plan, Rev. 10	7,566
IL-3	T-30	Use Tanks 4 through 8 for HLW Concentrate Storage.	3,750
IL-6	S-11	Process Salt Cake with Low Cs-137 into Class B Saltstone.	3,430
IL-7	W-37	Process Salt Cake with Low Cs-137 into Class C Saltstone.	3,430
IL-5	A-40	DWPF Shutdown, FY-01 to FY-09.	3,393
IL-1	T-56	Build new HLW Waste Tanks.	3,200
IL-4	A-32	Tanks 4 – 8 for Emergency Space.	2,600
IL-8 *	N-11	Tanks in Reactor Areas for HLW.	2,000
IL-10	T-3	Evaporate backlog waste.	1,526
IL-13 *	D-6	Send DWPF recycle to Z-Area.	1,372
IL-16	T-57	Small Tanks for Emergency Space.	1,323
IL-17	A-38	Reduce Emergency Space to 1300K gallons.	1,300
IL-18	S-14	ETF Bottoms Direct to Saltstone.	1,200
IL-20 *	F-10	Send ETF Bottoms to ChemNuclear (HLW to Tank 50).	1,200
IL-21	W-11	New Tank for ETF Bottoms (HLW to Tank 50).	1,200
IL-69	N-19	Use Tanks from Reactor Areas for ETF Bottoms (HLW to Tank 50).	1,200
IL-72	T-48	Store ETF Bottoms in Type IV Tanks (HLW to Tank 50)	1,200
IL-11	D-12	Evaporator in the Salt Cell for DWPF Recycle.	1,176
IL-12	D-5	Treat DWPF recycle using CST and send to Saltstone.	1,176
IL-14	D-13	Evaporator in LWF for DWPF Recycle.	1,176
IL-15	D-37	Treat DWPF Recycle in a Waste Tank and Portable Unit to Meet WAC for Z-Area.	1,176
IL-24	D-27	Reduce DWPF Production to 125 Canisters Per Year	1,175
IL-22	W-4	Allow TPB in Tank 49 to Decompose (HLW to Tank 49)	1,060
IL-9 *	A-34	Tank 48 and 49 as Emergency Space.	960

*Subsequently dropped from further consideration due to risk (see Section 7.5).

7.3 *Intermediate List Overviews*

Each of the twenty-four (24) ideas making up the “*Intermediate List*” has unique features, assumptions, and unit operations associated with it. The SM Team developed more detailed summaries of each “*Intermediate List*” ideas for the purpose of clarifying the idea and to prevent multiple interpretations. The method used to document these overviews is referred to as an Idea Overview Summary and are provided in Reference 9. The overviews were used to further evaluate the ideas during the Evaluation Phase. As part of the idea overviews, the profile of the Ten-Year Increase in Available Space over the period of FY2000 through FY2009 was also determined.

7.4 *Ideas Not On Intermediate List*

Forty-eight (48) “*Initial List*” ideas did not meet the criterion of producing >900K gallons of TIAS. However, the SM Team did not want to ignore the possibility that, of these forty-eight ideas, there may be relatively simple and cost effective solutions, albeit in smaller space gains, which may be usable in developing long term Strategies for HLW space management. As such, these forty-eight ideas were considered as potential small space gain contributors if they fell into one of two classifications referred to as 1) “Fix-it-now” , and 2) “Easy-to-implement”. The criteria for each is:

- “Fix-it-now” Ideas: An idea, with < 900K gallons of TIAS, which is considered low risk because it is estimated to cost < \$500 K and requires < six months to implement.
- “Easy-to-implement” Ideas: An idea, with < 900K gallons of TIAS, which is considered low risk because it requires six (6) to eighteen months to implement.

Upon SM Team review, it was determined that none of the ideas fit the “Fix-it-now” classification. Table 7-3 lists the “Small Volume Gains” associated with the “Easy-to-implement” ideas. Details of the SM Team’s disposition on these ideas are contained in Reference 9.

Table 7-3: “Small Volume Gains” Ideas

INITIAL LIST IDEA NO.	INITIAL LIST IDEA TITLE	ESTIMATED TIME TO IMPLEMENT	ESTIMATED COST TO IMPLEMENT	TIAS (UNITS = K GALLONS)	COMMENTS
W-29	Perform Al Dissolution with High Hydroxide Waste Use waste with high hydroxide concentration for aluminum dissolution rather than fresh sodium hydroxide.	12 Mo.	300K 100K FY01 200K FY02	585 135 FY03 194 FY06 256 FY09	Sludge Batch 3 Al Diss – FY02 Sludge Batch 4 Al Diss – FY05 Sludge Batch 3 Al Diss – FY08
A-18	Revisit Tank Farm WAC Revise the Tank Farm WAC to eliminate practices that affect space negatively, especially excess caustic additions and dilution required in canyon.	18 Mo.	500K 100K FY00 200K FY01 200K FY02	480 Evenly spread over 10 years	- Engineering resources needed. Requires WAC revisions. - Increased operational complexity - TIAS may be impacted if other major ideas implemented
T-13	Add Telescoping Transfer Jets to Selected Tanks Some current jets don’t allow full evaporation of existing waste. Also, Telescoping transfer jets in drop tanks may allow feed to be drawn from layers in tanks to promote maximum space regain, evaporator efficiency and minimize salt drop out as salt cake.	12 Mo. Ea.	1,000K 250K FY00 (Tk35) 250K FY01 (Tk39) 250K FY02 (Tk30) 250K FY03 (Tk38)	500 300 FY01 200 FY02 Future gains TBD	Project to purchase new jets and dispose of existing jets required. Emphasis on Tanks 35 and 39 for largest TIAS gain.

INITIAL LIST IDEA NO.	INITIAL LIST IDEA TITLE	ESTIMATED TIME TO IMPLEMENT	ESTIMATED COST TO IMPLEMENT	TIAS (UNITS = K GALLONS)	COMMENTS
T-37	<p>Use the Type IV Tanks to Store Wastes with Low Activity</p> <p>Use Type IV Tanks (Tanks 23 & 24) for long term storage of low activity waste (e.g. DWPF recycle and ESP Washwater) up to 2.6 Million gallons, if space not available in Type III tanks</p>	6 Mo. Per Tank	<p>500K</p> <p>250K FY00 250K FY01</p>	<p>260</p> <p>Implemented on as needed basis.</p>	Requires credible transfer path to Tanks 23 and 24. Could be above ground. Install early to provide maximum flexibility.
T-87	<p>Reclaim Tank 26 by placing 2F evaporator in Warm Standby.</p> <p>Place 2F evaporator in Warm Standby and use reserved Tank 26/40 working space for concentrated supernate storage.</p>	12 Mo.	500K	<p>200</p> <p>See comment section for implementation timing.</p>	<ul style="list-style-type: none"> Several factors must be assessed before implementation: <ul style="list-style-type: none"> - Operating condition of 2 hand of RHLWE. - Need for salt space versus Tank 46 salt level. - F canyon processing plans. Potential for higher TIAS value <ul style="list-style-type: none"> - Dependent on concentration of waste in Tank 46 and 26. - Eliminate Tank 26 feed pump operating limit restriction.

INITIAL LIST IDEA NO.	INITIAL LIST IDEA TITLE	ESTIMATED TIME TO IMPLEMENT	ESTIMATED COST TO IMPLEMENT	TIAS (UNITS = K GALLONS)	COMMENTS
D-19	Shut Off SAS Steam During DWPF Melter Idle During melter idling, flow to both SASs in the DWPF Melter Off Gas system should be stopped after the cold cap has disappeared (~6 hr.)	6 Mo.	50K 50K FY00	146 Evenly spread over 10 years. Value must be adjusted if Recycle treated.	Procedure & A/B revisions.
D-28	Bypass LPPP Recycle Waste Tank Current RCT transfer operations requires three batch transfers to the Recycle Waste Tank (RWT) in the Low Point Pump Pit (LPPP). By bypassing the RWT in the LPPP and transferring directly to the Tank Farm, two RCT pump primes in the DWPF are eliminated (~120 gal/RCT batch).	18 Mo.		44	Procedure changes.
D-30	Unplug SMECT Scrubber Pump Prime System Line SMECT scrubber pump has plugged J-Tube which prevents priming the pump at low tank levels, so several thousand gallons of water must be added to restart pump (4 to 6 times a year).	1 Yr.	250K	38	Repair pump.

INITIAL LIST IDEA NO.	INITIAL LIST IDEA TITLE	ESTIMATED TIME TO IMPLEMENT	ESTIMATED COST TO IMPLEMENT	TIAS (UNITS = K GALLONS)	COMMENTS
W-33	Optimize Washwater Use at ESP Optimize sludge washing to reduce the amount of wash water. Develop detailed fragnets and assumptions for aluminum dissolution and washing.	6 Mo.		21	Use DWPF recycle water for washwater where possible.
C-20	Reduce NMSS Waste Receipts Reduce NMSS waste as much as possible without curtailing missions, e.g., reduce PVV flushes, increase acid stripping, use HAN, eliminate or decrease poisons, use electrolytic dissolver to destroy nitrate.	18 Mo.		1	This item would work with A-14, A-13, and A-18, to aid in material tracking and better performance.
T-24	Optimize Use of Flush Water After Transfers Flush water can be minimized by making it an optimization criteria for planning a transfer.	1 Yr.		1	Revise procedures.
A-12	Develop Better Performance Indicators Develop better performance indicators for material movement so that decision makers are attuned to when something will impact Tank Farm space.	1 Yr.		<1	Improved performance.

INITIAL LIST IDEA NO.	INITIAL LIST IDEA TITLE	ESTIMATED TIME TO IMPLEMENT	ESTIMATED COST TO IMPLEMENT	TIAS (UNITS = K GALLONS)	COMMENTS
A-13	Confirm Space Gain Factors Confirm space gain factors to improve our ability to confidently plan future Tank Farm space.	1 Yr.		<1	Improved material tracking.
A-14	Improve WCS Database Improve WCS database to 1) ensure information is update, 2) better waste characterization. Would improve our ability to confidently forecast.	1 Yr.		<1	Improved material tracking.
T-9	Optimize Evaporator Operation Determine best way to operate evaporators to maximize space gain, e.g., make liquor where appropriate rather than salt cake, continuous vs. batch processing, recycle timing.	1 Yr.		<1	Improved operations.

7.5 Risk Analysis of *Intermediate List* Ideas

This section describes the process and results of the risk analysis performed on the *Intermediate List* ideas.

Risk Analysis is vital to the success of any program strategy or project. In order to credibly claim an expectation of success in any activity, it is necessary to investigate potential risk, devise Strategies to minimize threats to success, and assess the residual risk. Risk management was also prescribed as a SM Team activity in the Charter.²

While the SM Team recognized that risk analysis was a necessary component of chartered activities, it also recognized that the detail to which risk analysis could be applied varied with the depth of knowledge available as the ideas and Strategies evolved. In order to assure objective and uniform assignment of risk, risks were based on the perceived capability of how well the idea or Strategies could meet the defined Strategy Input⁵. The analysis focused on the ability to meet the necessary and sufficient functions and requirements.

The risk analysis was conducted in accordance with desktop procedure⁶ entitled, "Risk Analysis". The analysis was based on the level of detail available. The methodology used to analyze risk is depicted in Figure 7-3. Risk analysis includes the identification of risk, assessing the significance and likelihood of risk, and defining risk handling strategies with associated costs and schedules to implement. The definitions relevant to this process are described in Section 10.0 (Glossary).

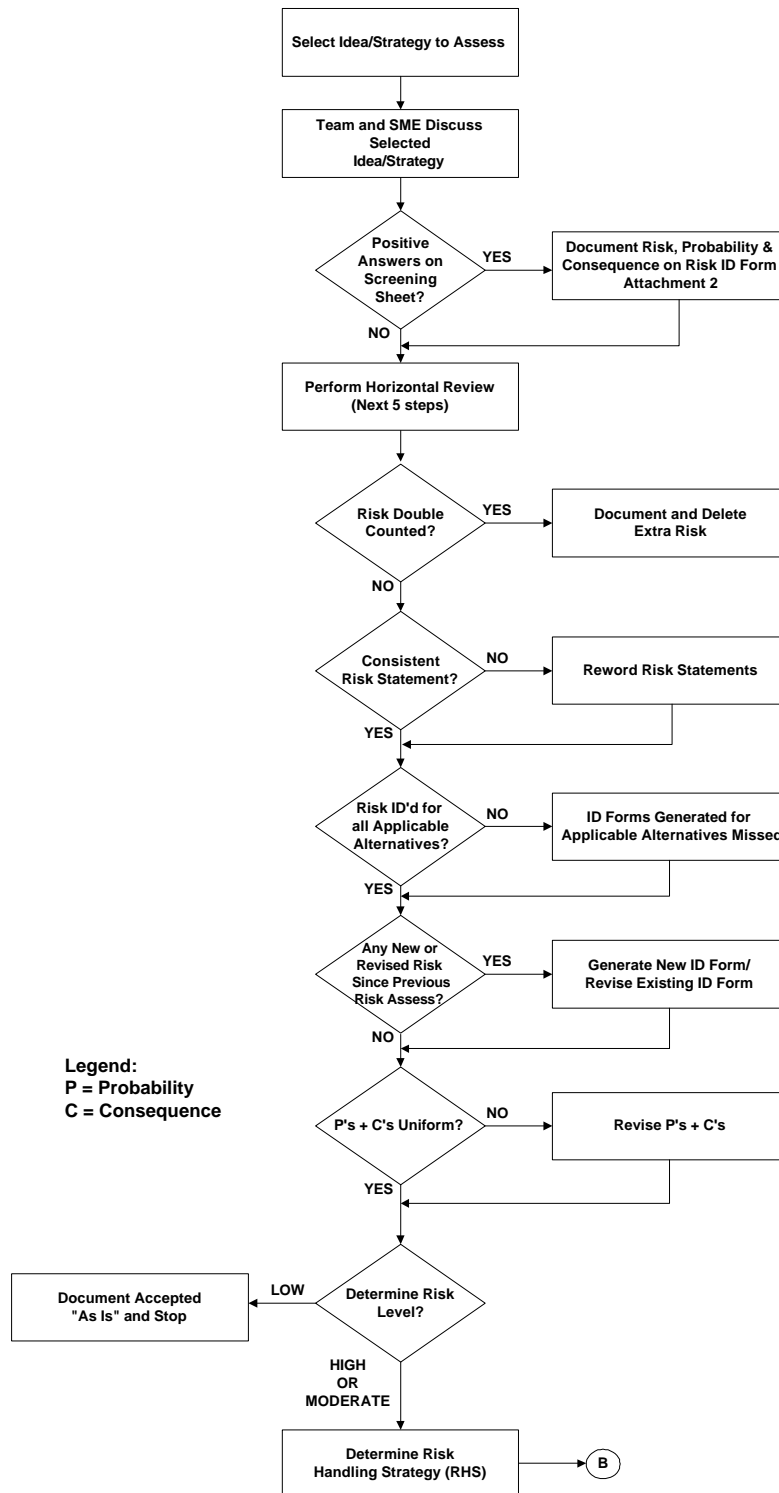


Figure 7-3: Risk Analysis Process

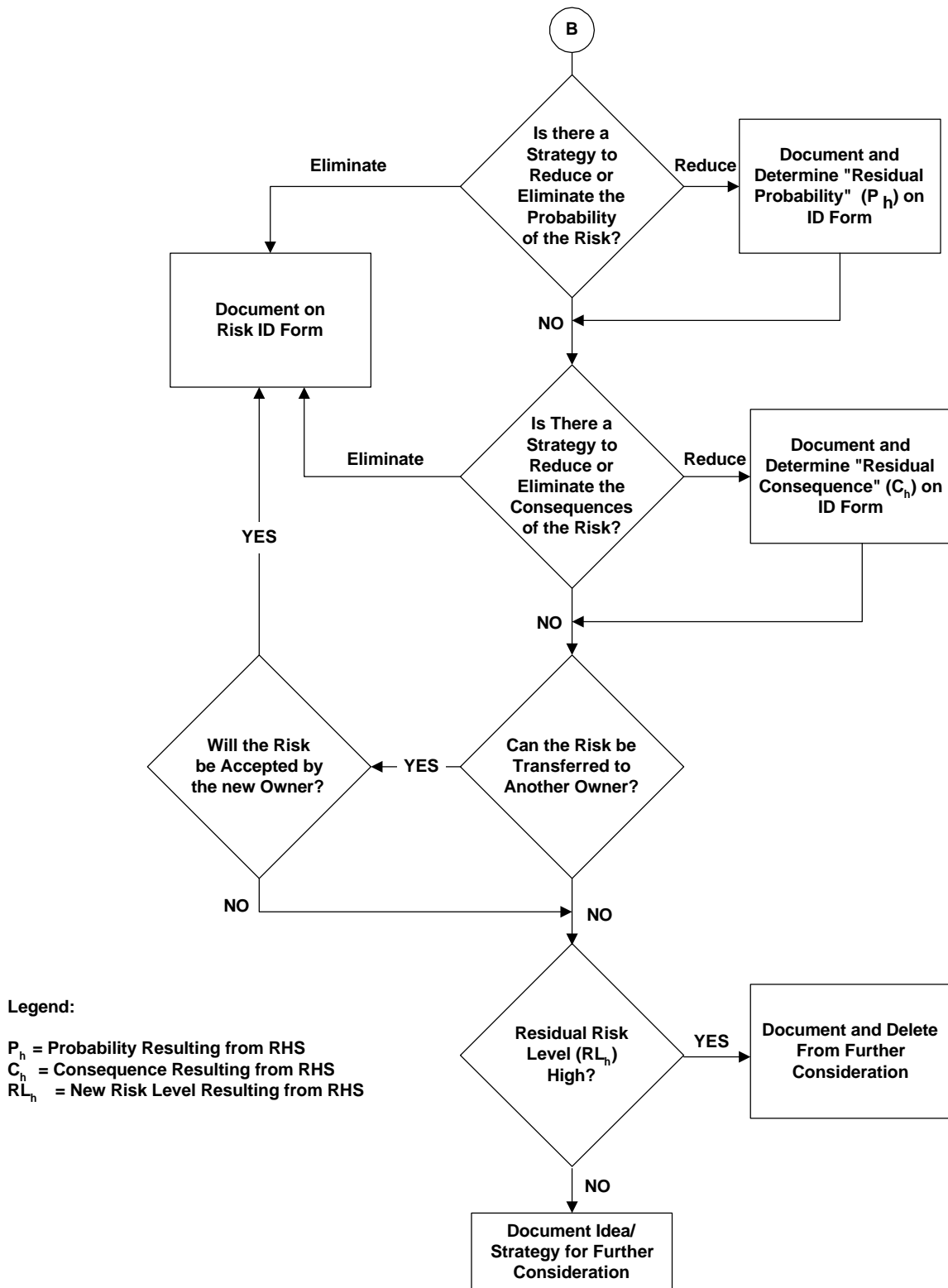


Figure 7-3: Risk Analysis Process (Cont.)

7.5.1 Risk Analysis of *Intermediate List* Ideas

A risk assessment was performed on the *Intermediate List* of ideas. Each idea was independently analyzed for risk. The risk assessment started with the development of a risk screening checklist. Available templates were reviewed by the SM Team and modified to reflect risk areas and questions that the SM Team felt were applicable to the mission. The identified risk screening areas were *mission*, *receipt of waste*, *storage of waste*, *processing of waste*, *removal of waste*, and *“other”*. Each screening area had between two (2) and six (6) detailed questions to help develop appropriate risks.

The ideas were then individually screened and analyzed for risks. When a potential risk was determined, a “Statement of Risk” was defined. An identification form was created for each risk statement. This form also contains SM Team evaluations of probability and consequences of the risk occurrences. Probability and consequence were stated qualitatively. The bases for the probabilities and consequences are recorded on the forms.

After the checklist areas and forms were completed for an idea, the SM Team performed a horizontal review to assure that probabilities and consequences were uniformly and consistently stated. This review assured that risks were applied to each applicable idea and that consistent levels were used for comparable risks.

Risk handling strategies were then developed for “high” risks. High risks were defined as those with probability and consequence levels as shown in Table 7-4. The risk handling strategy developed was documented on the identification form and, where applicable, the impacts of the handling strategy on risk probability and consequence were estimated and documented.

PROBABILITY OF RISK OCCURRING	Very Likely	Low Risk	Moderate Risk	High Risk	High Risk
	Likely	Low Risk	Moderate Risk	High Risk	High Risk
	Unlikely	Low Risk	Moderate Risk	Moderate Risk	High Risk
	Very Unlikely	Low Risk	Low Risk	Moderate Risk	Moderate Risk
		Negligible	Marginal	Significant	Critical
SEVERITY OF CONSEQUENCE					

Table 7-4: Risk Level (RL) Determination Matrix

7.5.2 Results of Risk Analysis

The assessment and development of risk handling strategies was useful to the SM Team as a means of identifying risks associated with the *Intermediate List* ideas, understanding the nature of the risks, developing approaches to address the risks, and *eliminating those ideas* which remained high risk from further consideration.

The ideas on the “*Intermediate List*” which were dropped from further consideration based on “unmitigable high risks” are:

- IL-8: “Use Tanks in Reactor Areas for HLW”

The high residual risk (8 B.3) remains because the complexity of the operations may be unmanageable. The complexity is deemed comparable to an inter-area transfer between F Tank Farm and H Tank Farm. Furthermore, six separate tank farms must be operated to implement this idea. For these tanks, 200 separate transfers are needed to fill each tank. Tanks are several miles from existing Tank Farms and waste must be transported over roads.

- IL-9: “Make Tanks 48 & 49 Emergency Spare Tanks”

The high residual risk (9 B.5) remains because of the inability to develop an Authorization Basis (AB) for Tank 48 that will address the safety issues associated with adding waste to Tank 48. Reuse of Tank 49 alone is addressed in IL-22.

- IL-13: “Send DWPF Recycle Directly to Saltstone”

The high residual risk (13 A.2) remains because of a concern that DOE will not agree to dispose of TRU waste at SRS. Saltstone made from this waste could exceed Class C grout for alpha activity and be classified as TRU waste.

- IL-20: “Send ETF Bottoms to ChemNuclear (HLW to Tank 50)”

The high residual risk (20 A.2) remains because of the possibility that the ChemNuclear plant may not be able to accept RCRA waste for processing and disposal. Chromate in the waste will cause dried salt to fail TCLP. Waste would be classified as mixed waste.

The “Results Report on the Risk Analysis of *Intermediate List* Ideas”¹² contains the detailed risk analysis information by the SM Team for each *Intermediate List* idea.

8.0 Strategy Development

This section defines the process and results obtained in developing Strategies which satisfy the functions and requirements. The functions and requirements are defined in the Strategy Input Package⁵. The model used to develop Strategies is illustrated in Figure 8-1.

The *Intermediate List* of ideas which were individually assessed for risks (Section 7.0) became the inputs the SM Team used to “develop” various Strategies. Each idea or combination of ideas which satisfies the minimum requirements of the SIP⁵ with respect to available space in the timeframe needed, was identified.

The desktop procedure methodology used to develop Strategies is described in Reference 6.

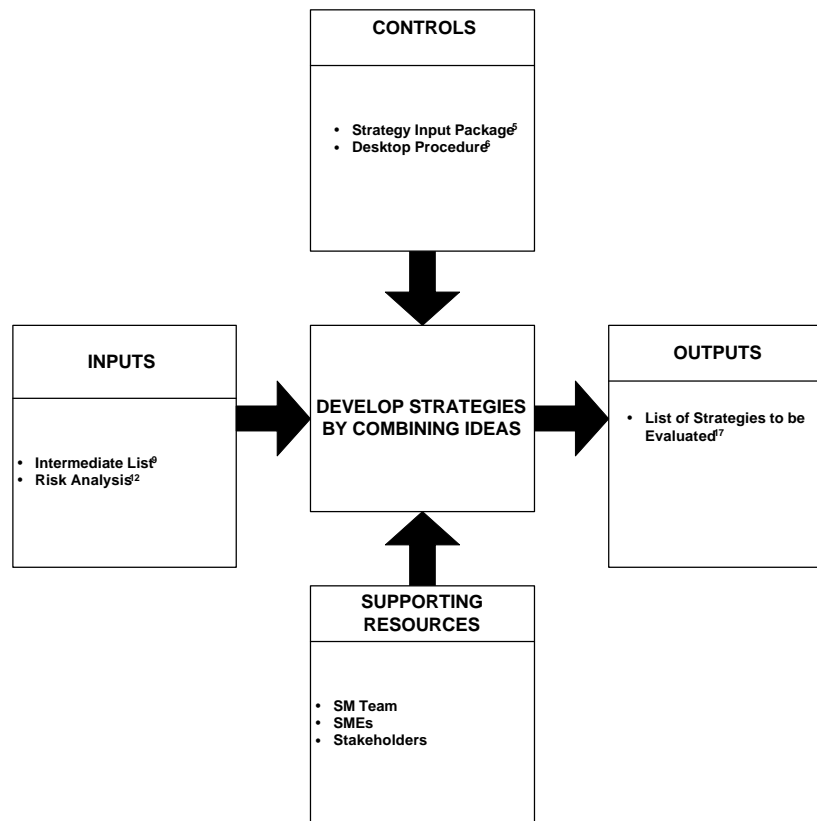


Figure 8-1: Model of Inputs, Controls, Supports and Outputs in Developing a List of Strategies

8.1 Available Space Baseline (ASB) Profile

Intermediate List idea IL-2 is the only individual idea which satisfied the ASB⁴ and was considered a Strategy (S-114) for subsequent evaluation purposes and removed from the *Intermediate List*. IL-2 actually consists of *Intermediate List* ideas 10, 22, 18, and 3. Because none of the remaining individual nineteen (19) *Intermediate List* ideas satisfies the Ten-Year Increase in Available Space (TIAS) needed, ideas must be combined to yield a Strategy that will provide the needed space. To prevent combinations of ideas that will not provide the space needed each year, an ASB⁴ profile for the space needed was developed as shown in Figure 8-2. The data show a total space need of 5,600 Kgal through FY2009 and 6,040 Kgal through March of 2010, which is six months beyond the period of interest (FY2000 through FY2009). To assure a Strategy would provide the space throughout the desired time range, the ASB⁴ value for FY2009 was increased from 5,600 Kgal to 6,040 Kgal.

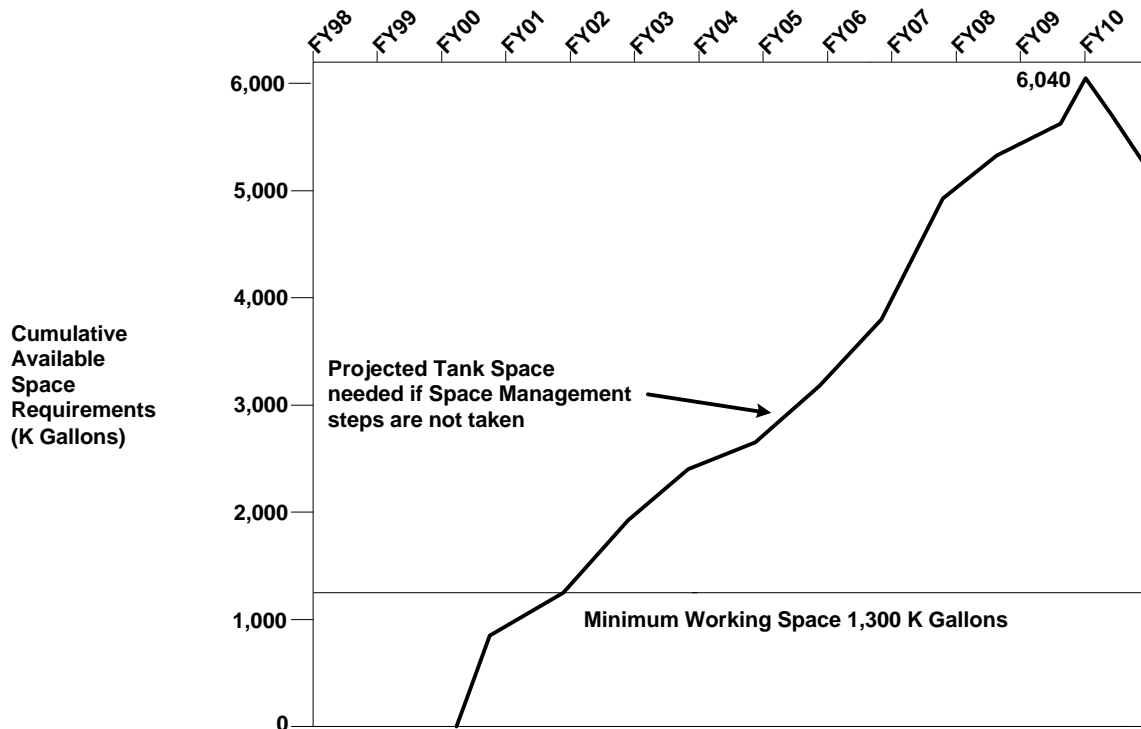


Figure 8-2: Cumulative Increase in Available Space Needed per ASB⁴

8.2 Elimination of Combinations with Mutually Exclusive Ideas

Because several of the *Intermediate List* ideas are functionally equivalent, groupings of mutually exclusive ideas were developed to prevent combinations containing two or more functionally equivalent ideas. For example, a combination of ideas cannot contain both “DWPF Shutdown” and “Reduce DWPF Production to 125 Canisters per Year” since it is physically impossible to implement both of these ideas in a single Strategy. A matrix identifying mutually exclusive ideas is shown in Figure 8-3.

IL No.	IL-3	IL-6	IL-7	IL-5	IL-1	IL-4	IL-10	IL-16	IL-17	IL-18	IL-21	IL-69	IL-72	IL-11	IL-12	IL-14	IL-15	IL-24	IL-22	
IL-22																			IL-22	Allow TPB in Tank 49 to Decompose
IL-24				IL-5										IL-11	IL-12	IL-14	IL-15	IL-24		Reduce to 125 DWPF Canisters per year
IL-15				IL-5										IL-11	IL-12	IL-14	IL-15			Treat DWPF Recycle by IX in Tank Farm
IL-14				IL-5										IL-11	IL-12	IL-14				Evaporator in LWF for DWPF Recycle
IL-12				IL-5										IL-11	IL-12					IX in LWF for DWPF Recycle
IL-11				IL-5										IL-11						Evaporator in Salt Cell for ETF Bottoms
IL-72		IL-6	IL-7							IL-18	IL-21	IL-69	IL-72							Store ETF Bottoms in Type IV Tanks
IL-69		IL-6	IL-7							IL-18	IL-21	IL-69								Tanks from Reactor Areas For ETF Bottoms
IL-21		IL-6	IL-7							IL-18	IL-21									New Tank For ETF Bottoms
IL-18		IL-6	IL-7							IL-18										ETF Bottoms Direct to Z Area
IL-17										IL-17										Reduce Emergency Space to 1300 Kgal
IL-16						IL-4		IL-16												Small Tanks for Emergency Space
IL-10							IL-10													Evaporate Backlog Waste
IL-4	IL-3					IL-4														Tanks 4-8 for Emergency Space
IL-1					IL-1															Build New HLW Tanks
IL-5				IL-5																DWPF Shutdown FY01-FY09
IL-7		IL-6	IL-7																	Low Cs-137 Salt into Class C Saltstone
IL-6		IL-6																		Low Cs-137 Salt into Class B Saltstone
IL-3	IL-3																			Tanks 4-8 for Concentrate Storage

Figure 8-3: Matrix of Mutually Exclusive Ideas

LEGEND: Shaded boxes identify mutually exclusive ideas.

8.3 Elimination of Combinations of Ideas Failing to Meet the ASB Profile

Any combinations of ideas that met or exceeded the volumes defined by the ASB⁴ curve were retained as possible Strategies and combinations that failed to meet the ASB⁴ volume needs throughout the period were eliminated. After eliminating combinations that failed to meet the ASB⁴ curve, a total of 530 possible combinations of ideas remained.

8.4 Elimination of Duplicate Combinations of Ideas

As combinations of ideas were developed, a different order for the same combination of ideas was often generated, leading to duplicate combinations. Because these combinations are composed of the same ideas, those duplicates would be eliminated.

8.5 Elimination of Superfluous Combinations of Ideas

The list also contains superfluous Strategies, in which an unneeded idea was added to a combination that already met the ASB⁴ curve for all ten years. Superfluous combinations were eliminated by comparing the remaining list of combination of ideas independently generated¹⁴. After elimination of superfluous ideas a total of 179 combinations of ideas remained. These were designated as unique Strategies for further evaluation.

8.6 Identified Strategies

The list of identified Strategies is provided in Table 8-1. This list represents *each combination of Intermediate List* ideas which satisfy the minimum requirements of the ASB⁴ and are non-duplicative and non-superfluous. The “Results Report on the Development of Tank Space Management Strategies”¹⁶ details SM Team activities in the developmental documentation of the 179 strategies.

Table 8-1: HLW Tank Space Management Strategy List

Strategy Tracking Number	Strategy (Intermediate List Ideas and Sequence of Implementation)	Average Annual Surplus relative to space need curve (kgal)	Cumulative IAS by Year and Sorted by Ascending									
			TIAS (K-Gal) in the Year 2009									
			Year 2000	Year 2001	Year 2002	Year 2003	Year 2004	Year 2005	Year 2006	Year 2007	Year 2008	Year 2009
S-1	10,5,18	592	1044	2200	2428	2820	3122	4628	5065	5430	5681	6119
S-2	10,5,21	712	1044	2200	2428	2820	4322	4628	5065	5430	5681	6119
S-3	10,5,72	832	1044	2200	2428	4020	4322	4628	5065	5430	5681	6119
S-4	10,5,69	712	1044	2200	2428	2820	4322	4628	5065	5430	5681	6119
S-5	10,17,5	1162	1044	3500	3728	4120	4422	4728	5165	5530	5781	6219
S-6	10,5,16	512	1044	2200	2428	2820	3122	3806	4715	5553	5804	6242
S-7	10,17,6	633	759	2826	2826	2826	2826	4056	4926	5386	6256	6256
S-8	10,17,7	633	759	2826	2826	2826	2826	4056	4926	5386	6256	6256
S-9	10,17,22,24,18	1484	868	4180	4010	4257	4414	5733	5781	5924	6030	6261
S-10	10,17,22,24,21	1604	868	4180	4010	4257	5614	5733	5781	5924	6030	6261
S-11	10,17,22,24,72	1724	868	4180	4010	5457	5614	5733	5781	5924	6030	6261
S-12	10,17,22,24,69	1604	868	4180	4010	4257	5614	5733	5781	5924	6030	6261
S-13	10,17,22,11,18	1323	759	3886	3886	3886	4082	5478	5674	5870	6066	6262
S-14	10,17,22,12,18	1323	759	3886	3886	3886	4082	5478	5674	5870	6066	6262
S-15	10,17,22,14,18	1323	759	3886	3886	3886	4082	5478	5674	5870	6066	6262
S-16	10,17,22,15,18	1323	759	3886	3886	3886	4082	5478	5674	5870	6066	6262
S-17	10,17,22,11,21	1443	759	3886	3886	3886	5282	5478	5674	5870	6066	6262
S-18	10,17,22,12,21	1443	759	3886	3886	3886	5282	5478	5674	5870	6066	6262
S-19	10,17,22,14,21	1443	759	3886	3886	3886	5282	5478	5674	5870	6066	6262
S-20	10,17,22,15,21	1443	759	3886	3886	3886	5282	5478	5674	5870	6066	6262
S-21	10,17,22,11,72	1563	759	3886	3886	5086	5282	5478	5674	5870	6066	6262
S-22	10,17,22,12,72	1563	759	3886	3886	5086	5282	5478	5674	5870	6066	6262
S-23	10,17,22,14,72	1563	759	3886	3886	5086	5282	5478	5674	5870	6066	6262
S-24	10,17,22,15,72	1563	759	3886	3886	5086	5282	5478	5674	5870	6066	6262
S-25	10,17,22,11,69	1443	759	3886	3886	3886	5282	5478	5674	5870	6066	6262
S-26	10,17,22,12,69	1443	759	3886	3886	3886	5282	5478	5674	5870	6066	6262
S-27	10,17,22,14,69	1443	759	3886	3886	3886	5282	5478	5674	5870	6066	6262
S-28	10,17,22,15,69	1443	759	3886	3886	3886	5282	5478	5674	5870	6066	6262
S-29	10,22,24,16,18	834	868	2880	2710	2957	3114	4811	5331	5947	6053	6284
S-30	10,22,21,24,16	954	868	2880	2710	2957	4314	4811	5331	5947	6053	6284
S-31	10,22,72,24,16	1074	868	2880	2710	4157	4314	4811	5331	5947	6053	6284
S-32	10,22,69,24,16	954	868	2880	2710	2957	4314	4811	5331	5947	6053	6284

Strategy Tracking Number	Strategy (Intermediate List Ideas and Sequence of Implementation)	Average Annual Surplus relative to space need curve (kgal)	Cumulative IAS by Year and Sorted by Ascending									
			TIAS (K-Gal) in the Year 2009									
			Year 2000	Year 2001	Year 2002	Year 2003	Year 2004	Year 2005	Year 2006	Year 2007	Year 2008	Year 2009
S-33	10,22,21,11,16	793	759	2586	2586	2586	3982	4556	5224	5893	6089	6285
S-34	10,22,21,12,16	793	759	2586	2586	2586	3982	4556	5224	5893	6089	6285
S-35	10,22,21,14,16	793	759	2586	2586	2586	3982	4556	5224	5893	6089	6285
S-36	10,22,21,15,16	793	759	2586	2586	2586	3982	4556	5224	5893	6089	6285
S-37	10,22,72,11,16	913	759	2586	2586	3786	3982	4556	5224	5893	6089	6285
S-38	10,22,72,12,16	913	759	2586	2586	3786	3982	4556	5224	5893	6089	6285
S-39	10,22,72,14,16	913	759	2586	2586	3786	3982	4556	5224	5893	6089	6285
S-40	10,22,72,15,16	913	759	2586	2586	3786	3982	4556	5224	5893	6089	6285
S-41	10,22,69,11,16	793	759	2586	2586	2586	3982	4556	5224	5893	6089	6285
S-42	10,22,69,12,16	793	759	2586	2586	2586	3982	4556	5224	5893	6089	6285
S-43	10,22,69,14,16	793	759	2586	2586	2586	3982	4556	5224	5893	6089	6285
S-44	10,22,69,15,16	793	759	2586	2586	2586	3982	4556	5224	5893	6089	6285
S-45	10,4,22,24	949	868	2880	3460	3707	3864	3983	5531	5674	5780	6361
S-46	10,4,22,11	788	759	2586	3336	3336	3532	3728	5424	5620	5816	6362
S-47	10,4,22,12	788	759	2586	3336	3336	3532	3728	5424	5620	5816	6362
S-48	10,4,22,14	788	759	2586	3336	3336	3532	3728	5424	5620	5816	6362
S-49	10,4,22,15	788	759	2586	3336	3336	3532	3728	5424	5620	5816	6362
S-50	10,17,22,24,16	1404	868	4180	4010	4257	4414	4911	5431	6047	6153	6384
S-51	10,17,22,11,16	1243	759	3886	3886	3886	4082	4656	5324	5993	6189	6385
S-52	10,17,22,12,16	1243	759	3886	3886	3886	4082	4656	5324	5993	6189	6385
S-53	10,17,22,14,16	1243	759	3886	3886	3886	4082	4656	5324	5993	6189	6385
S-54	10,17,22,15,16	1243	759	3886	3886	3886	4082	4656	5324	5993	6189	6385
S-55	10,4,22,18	977	759	2586	3336	3336	3336	4536	6036	6036	6036	6386
S-56	10,4,22,21	1097	759	2586	3336	3336	4536	4536	6036	6036	6036	6386
S-57	10,4,22,72	1217	759	2586	3336	4536	4536	4536	6036	6036	6036	6386
S-58	10,4,22,69	1097	759	2586	3336	3336	4536	4536	6036	6036	6036	6386
S-59	10,17,22,16,18	1431	759	3886	3886	3886	3886	5464	5936	6409	6409	6409
S-60	10,17,22,16,21	1551	759	3886	3886	3886	5086	5464	5936	6409	6409	6409
S-61	10,17,22,16,72	1671	759	3886	3886	5086	5086	5464	5936	6409	6409	6409
S-62	10,17,22,16,69	1551	759	3886	3886	3886	5086	5464	5936	6409	6409	6409
S-63	10,4,22,17	1547	759	3886	4636	4636	4636	4636	6136	6136	6136	6486
S-64	10,4,24,18	595	868	1820	2400	2647	2804	4123	5671	5814	5920	6501
S-65	10,4,24,21	715	868	1820	2400	2647	4004	4123	5671	5814	5920	6501
S-66	10,4,24,72	835	868	1820	2400	3847	4004	4123	5671	5814	5920	6501
S-67	10,4,24,69	715	868	1820	2400	2647	4004	4123	5671	5814	5920	6501

Strategy Tracking Number	Strategy (Intermediate List Ideas and Sequence of Implementation)	Average Annual Surplus relative to space need curve (kgal)	Cumulative IAS by Year and Sorted by Ascending									
			TIAS (K-Gal) in the Year 2009									
			Year 2000	Year 2001	Year 2002	Year 2003	Year 2004	Year 2005	Year 2006	Year 2007	Year 2008	Year 2009
S-68	10,4,72,11	674	759	1526	2276	3476	3672	3868	5564	5760	5956	6502
S-69	10,4,72,12	674	759	1526	2276	3476	3672	3868	5564	5760	5956	6502
S-70	10,4,72,14	674	759	1526	2276	3476	3672	3868	5564	5760	5956	6502
S-71	10,4,72,15	674	759	1526	2276	3476	3672	3868	5564	5760	5956	6502
S-72	10,17,24,18,16	1050	868	3120	2950	3197	3354	5051	5571	6187	6293	6524
S-73	10,17,24,21,16	1170	868	3120	2950	3197	4554	5051	5571	6187	6293	6524
S-74	10,17,24,72,16	1290	868	3120	2950	4397	4554	5051	5571	6187	6293	6524
S-75	10,17,24,69,16	1170	868	3120	2950	3197	4554	5051	5571	6187	6293	6524
S-76	10,17,18,16,11	889	759	2826	2826	2826	3022	4796	5464	6133	6329	6525
S-77	10,17,18,16,12	889	759	2826	2826	2826	3022	4796	5464	6133	6329	6525
S-78	10,17,18,16,14	889	759	2826	2826	2826	3022	4796	5464	6133	6329	6525
S-79	10,17,18,16,15	889	759	2826	2826	2826	3022	4796	5464	6133	6329	6525
S-80	10,17,21,16,11	1009	759	2826	2826	2826	4222	4796	5464	6133	6329	6525
S-81	10,17,21,16,12	1009	759	2826	2826	2826	4222	4796	5464	6133	6329	6525
S-82	10,17,21,16,14	1009	759	2826	2826	2826	4222	4796	5464	6133	6329	6525
S-83	10,17,21,16,15	1009	759	2826	2826	2826	4222	4796	5464	6133	6329	6525
S-84	10,17,72,16,11	1129	759	2826	2826	4026	4222	4796	5464	6133	6329	6525
S-85	10,17,72,16,12	1129	759	2826	2826	4026	4222	4796	5464	6133	6329	6525
S-86	10,17,72,16,14	1129	759	2826	2826	4026	4222	4796	5464	6133	6329	6525
S-87	10,17,72,16,15	1129	759	2826	2826	4026	4222	4796	5464	6133	6329	6525
S-88	10,17,69,16,11	1009	759	2826	2826	2826	4222	4796	5464	6133	6329	6525
S-89	10,17,69,16,12	1009	759	2826	2826	2826	4222	4796	5464	6133	6329	6525
S-90	10,17,69,16,14	1009	759	2826	2826	2826	4222	4796	5464	6133	6329	6525
S-91	10,17,69,16,15	1009	759	2826	2826	2826	4222	4796	5464	6133	6329	6525
S-92	10,4,24,17	1165	868	3120	3700	3947	4104	4223	5771	5914	6020	6601
S-93	10,4,17,11	1004	759	2826	3576	3576	3772	3968	5664	5860	6056	6602
S-94	10,4,17,12	1004	759	2826	3576	3576	3772	3968	5664	5860	6056	6602
S-95	10,4,17,14	1004	759	2826	3576	3576	3772	3968	5664	5860	6056	6602
S-96	10,4,17,15	1004	759	2826	3576	3576	3772	3968	5664	5860	6056	6602
S-97	10,17,18,4	1193	759	2826	3576	3576	3576	4776	6276	6276	6276	6626
S-98	10,17,21,4	1313	759	2826	3576	3576	4776	4776	6276	6276	6276	6626
S-99	10,4,72,17	1433	759	2826	3576	4776	4776	4776	6276	6276	6276	6626
S-100	10,17,69,4	1313	759	2826	3576	3576	4776	4776	6276	6276	6276	6626
S-101	10,17,22,1	1572	759	3886	3886	3886	3886	3886	3886	9086	8086	7086
S-102	10,22,24,6	989	868	2880	2710	2957	3114	4463	5381	5984	6960	7191

Strategy Tracking Number	Strategy (Intermediate List Ideas and Sequence of Implementation)	Average Annual Surplus relative to space need curve (kgal)	Cumulative IAS by Year and Sorted by Ascending									
			TIAS (K-Gal) in the Year 2009									
			Year 2000	Year 2001	Year 2002	Year 2003	Year 2004	Year 2005	Year 2006	Year 2007	Year 2008	Year 2009
S-103	10,22,24,7	989	868	2880	2710	2957	3114	4463	5381	5984	6960	7191
S-104	10,17,18,1	1218	759	2826	2826	2826	2826	4026	4026	9226	8226	7226
S-105	10,17,21,1	1338	759	2826	2826	2826	4026	4026	4026	9226	8226	7226
S-106	10,17,72,1	1458	759	2826	2826	4026	4026	4026	4026	9226	8226	7226
S-107	10,17,69,1	1338	759	2826	2826	2826	4026	4026	4026	9226	8226	7226
S-108	10,3,22,24	1064	868	2880	3460	3707	3864	3983	5531	5674	5780	7511
S-109	10,3,22,11	903	759	2586	3336	3336	3532	3728	5424	5620	5816	7512
S-110	10,3,22,12	903	759	2586	3336	3336	3532	3728	5424	5620	5816	7512
S-111	10,3,22,14	903	759	2586	3336	3336	3532	3728	5424	5620	5816	7512
S-112	10,3,22,15	903	759	2586	3336	3336	3532	3728	5424	5620	5816	7512
S-113	10,4,5	1227	1044	2200	3178	3570	3872	4178	6115	6480	6731	7519
S-114	10,3,22,18	1092	759	2586	3336	3336	3336	4536	6036	6036	6036	7536
S-115	10,3,22,21	1212	759	2586	3336	3336	4536	4536	6036	6036	6036	7536
S-116	10,3,22,72	1332	759	2586	3336	4536	4536	4536	6036	6036	6036	7536
S-117	10,3,22,69	1212	759	2586	3336	3336	4536	4536	6036	6036	6036	7536
S-118	10,3,22,17	1662	759	3886	4636	4636	4636	4636	6136	6136	6136	7636
S-119	10,3,24,18	710	868	1820	2400	2647	2804	4123	5671	5814	5920	7651
S-120	10,3,24,21	830	868	1820	2400	2647	4004	4123	5671	5814	5920	7651
S-121	10,3,24,72	950	868	1820	2400	3847	4004	4123	5671	5814	5920	7651
S-122	10,3,24,69	830	868	1820	2400	2647	4004	4123	5671	5814	5920	7651
S-123	10,3,72,11	789	759	1526	2276	3476	3672	3868	5564	5760	5956	7652
S-124	10,3,72,12	789	759	1526	2276	3476	3672	3868	5564	5760	5956	7652
S-125	10,3,72,14	789	759	1526	2276	3476	3672	3868	5564	5760	5956	7652
S-126	10,3,72,15	789	759	1526	2276	3476	3672	3868	5564	5760	5956	7652
S-127	10,3,22,16	1011	759	2586	3336	3336	3336	3714	5686	6159	6159	7659
S-128	10,3,24,17	1280	868	3120	3700	3947	4104	4223	5771	5914	6020	7751
S-129	10,3,17,11	1119	759	2826	3576	3576	3772	3968	5664	5860	6056	7752
S-130	10,3,17,12	1119	759	2826	3576	3576	3772	3968	5664	5860	6056	7752
S-131	10,3,17,14	1119	759	2826	3576	3576	3772	3968	5664	5860	6056	7752
S-132	10,3,17,15	1119	759	2826	3576	3576	3772	3968	5664	5860	6056	7752
S-133	10,17,18,3	1308	759	2826	3576	3576	3576	4776	6276	6276	6276	7776
S-134	10,17,21,3	1428	759	2826	3576	3576	4776	4776	6276	6276	6276	7776
S-135	10,3,72,17	1548	759	2826	3576	4776	4776	4776	6276	6276	6276	7776
S-136	10,17,69,3	1428	759	2826	3576	3576	4776	4776	6276	6276	6276	7776
S-137	10,3,72,16	897	759	1526	2276	3476	3476	3854	5826	6299	6299	7799

Strategy Tracking Number	Strategy (Intermediate List Ideas and Sequence of Implementation)	Average Annual Surplus relative to space need curve (kgal)	Cumulative IAS by Year and Sorted by Ascending									
			TIAS (K-Gal) in the Year 2009									
			Year 2000	Year 2001	Year 2002	Year 2003	Year 2004	Year 2005	Year 2006	Year 2007	Year 2008	Year 2009
S-138	10,3,17,16	1227	759	2826	3576	3576	3576	3954	5926	6399	6399	7899
S-139	10,22,24,18,1	1574	868	2880	2710	2957	3114	4433	4481	9824	8930	8161
S-140	10,22,21,24,1	1694	868	2880	2710	2957	4314	4433	4481	9824	8930	8161
S-141	10,22,72,24,1	1814	868	2880	2710	4157	4314	4433	4481	9824	8930	8161
S-142	10,22,69,24,1	1694	868	2880	2710	2957	4314	4433	4481	9824	8930	8161
S-143	10,22,21,11,1	1533	759	2586	2586	2586	3982	4178	4374	9770	8966	8162
S-144	10,22,21,12,1	1533	759	2586	2586	2586	3982	4178	4374	9770	8966	8162
S-145	10,22,21,14,1	1533	759	2586	2586	2586	3982	4178	4374	9770	8966	8162
S-146	10,22,21,15,1	1533	759	2586	2586	2586	3982	4178	4374	9770	8966	8162
S-147	10,22,72,11,1	1653	759	2586	2586	3786	3982	4178	4374	9770	8966	8162
S-148	10,22,72,12,1	1653	759	2586	2586	3786	3982	4178	4374	9770	8966	8162
S-149	10,22,72,14,1	1653	759	2586	2586	3786	3982	4178	4374	9770	8966	8162
S-150	10,22,72,15,1	1653	759	2586	2586	3786	3982	4178	4374	9770	8966	8162
S-151	10,22,69,11,1	1533	759	2586	2586	2586	3982	4178	4374	9770	8966	8162
S-152	10,22,69,12,1	1533	759	2586	2586	2586	3982	4178	4374	9770	8966	8162
S-153	10,22,69,14,1	1533	759	2586	2586	2586	3982	4178	4374	9770	8966	8162
S-154	10,22,69,15,1	1533	759	2586	2586	2586	3982	4178	4374	9770	8966	8162
S-155	10,22,24,16,1	1494	868	2880	2710	2957	3114	3611	4131	9947	9053	8284
S-156	10,22,21,16,1	1641	759	2586	2586	2586	3786	4164	4636	10309	9309	8309
S-157	10,22,72,16,1	1761	759	2586	2586	3786	3786	4164	4636	10309	9309	8309
S-158	10,22,69,16,1	1641	759	2586	2586	2586	3786	4164	4636	10309	9309	8309
S-159	10,5,6	1267	1044	2200	2428	2820	3122	4658	5965	6790	7911	8349
S-160	10,5,7	1267	1044	2200	2428	2820	3122	4658	5965	6790	7911	8349
S-161	10,17,24,16,1	1710	868	3120	2950	3197	3354	3851	4371	10187	9293	8524
S-162	10,17,11,16,1	1549	759	2826	2826	2826	3022	3596	4264	10133	9329	8525
S-163	10,17,12,16,1	1549	759	2826	2826	2826	3022	3596	4264	10133	9329	8525
S-164	10,17,14,16,1	1549	759	2826	2826	2826	3022	3596	4264	10133	9329	8525
S-165	10,17,15,16,1	1549	759	2826	2826	2826	3022	3596	4264	10133	9329	8525
S-166	10,4,72,1	1523	759	1526	2276	3476	3476	3476	4976	10176	9176	8526
S-167	10,4,22,6	1652	759	2586	3336	3336	3336	4566	6936	7396	8266	8616
S-168	10,4,22,7	1652	759	2586	3336	3336	3336	4566	6936	7396	8266	8616
S-169	10,4,17,1	1853	759	2826	3576	3576	3576	3576	5076	10276	9276	8626
S-170	10,3,5	1342	1044	2200	3178	3570	3872	4178	6115	6480	6731	8669
S-171	10,4,24,6	1270	868	1820	2400	2647	2804	4153	6571	7174	8150	8731
S-172	10,4,24,7	1270	868	1820	2400	2647	2804	4153	6571	7174	8150	8731

Strategy Tracking Number	Strategy (<i>Intermediate List Ideas and Sequence of Implementation</i>)	Average Annual Surplus relative to space need curve (kgal)	Cumulative IAS by Year and Sorted by Ascending									
			<u>TIAS (K-Gal) in the Year 2009</u>									
			Year 2000	Year 2001	Year 2002	Year 2003	Year 2004	Year 2005	Year 2006	Year 2007	Year 2008	Year 2009
S-173	10,22,5,1	2206	1044	3260	3488	3880	4182	4488	4925	10490	9741	9179
S-174	10,3,72,1	1638	759	1526	2276	3476	3476	3476	4976	10176	9176	9676
S-175	10,3,22,6	1767	759	2586	3336	3336	3336	4566	6936	7396	8266	9766
S-176	10,3,22,7	1767	759	2586	3336	3336	3336	4566	6936	7396	8266	9766
S-177	10,3,17,1	1968	759	2826	3576	3576	3576	3576	5076	10276	9276	9776
S-178	10,3,24,6	1385	868	1820	2400	2647	2804	4153	6571	7174	8150	9881
S-179	10,3,24,7	1385	868	1820	2400	2647	2804	4153	6571	7174	8150	9881

9.0 Strategy Down-Selection

The process to evaluate and reduce the 179 Strategies identified in Section 8.0 to an overall Strategy is described in this section. The Strategy is designed to manage HLW tank space during the period from the present until 2009 when the Alternative Salt Facility begins to process salt solutions. The down-selection process used is shown in Figure 9-1, and is defined in the desktop procedure entitled “HLW Tank Space Strategy Selection Process.”⁶

9.1 Stage 1 Selection

The process used to reduce the number of Strategies from 179 to 18 is described in this section.

9.1.1 Development of Strategy Weighting

Multi-Attribute Utility Analysis (weighted evaluation criteria) (MAUA) was used to evaluate and rank the 179 identified Strategies. Weighted evaluation criteria and associated utility functions were used to provide a consistent ranking of the Strategies. The evaluation criteria, definitions, and relative weighting for each criterion are described in Table 9-1. The utility functions defined for each criterion and the utility function values assigned are provided in Table 9-2.

Utility functions are used to objectively evaluate Strategies against each weighted criterion by establishing a “measurable range of desirability.” Each Strategy was evaluated against each attribute by determining the utility function that best describes that attribute for each Strategy. The utility function values assigned to each Strategy are multiplied by the attribute weight and summed arithmetically to provide a numerical score for each Strategy.

9.1.2 Approval of Weighting Criteria

The HLW Salt Disposition Program Manager concurred¹⁰ with the SM Team’s recommended evaluation criteria, weights, utility functions and associated utility function values presented on Tables 9-1 and 9-2 before they were used.

9.1.3 Sensitivity Analysis

The Level 1 and Level 2 weighted evaluation criteria, shown in Table 9-2, were tested for sensitivity to small ($\pm 20\%$) changes. The details of this analysis are provided in Reference 11 and concluded that the criteria were insensitive to change unless these changes exceeded $\pm 20\%$.

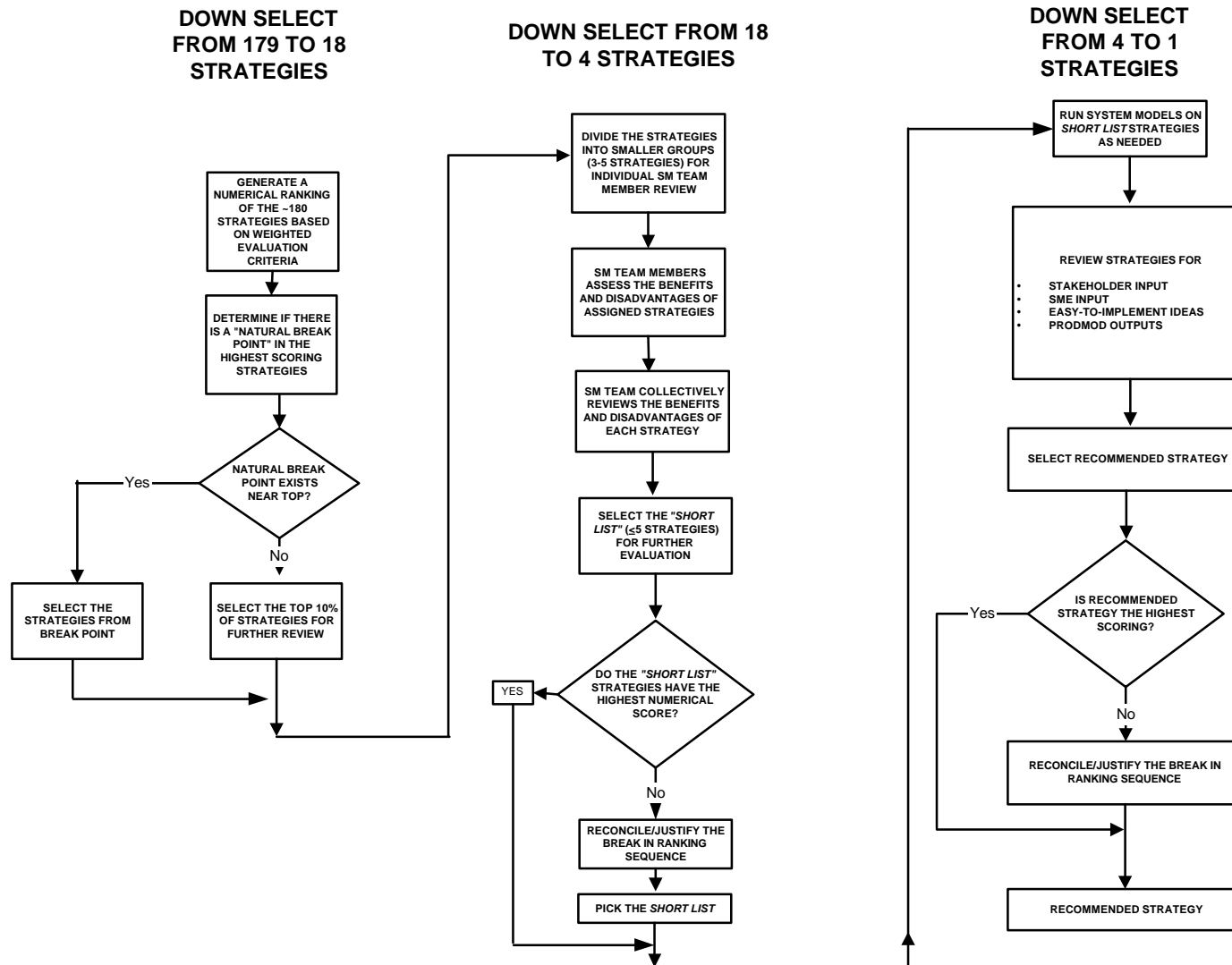


Figure 9-1: Multi-Stage Strategy Down-selection Process

**Table 9-1: HLW Tank Space Management Team Level 1 and Level 2 Evaluation
Criteria, Assigned Weights, and Definitions**

Criterion Title	Criterion No.	Assigned Weight	Definition
Strategy Exceeds Available Space Baseline	1.0	10 %	The degree to which the Strategy's annual Increase in Available Space (IAS) exceeds minimum required IAS in the "Available Space Baseline for Space Management Team Initiative", Revision 2.
Impact on Site Missions	2.0	30 %	The degree to which the Strategy supports operation of DWPF and closure of waste tanks.
DWPF Canister Production	2.1	50 %	The degree to which the Strategy supports DWPF canister production, expressed as canisters per year.
HLW Tank Closure	2.2	50 %	The number of HLW tanks that could be closed by 2011.*
Compatibility with Existing HLW Processes	3.0	30 %	The degree to which the Strategy uses existing HLW and SRS infrastructure and permits.
Use of Existing Facilities	3.1	20 %	The degree to which existing facilities are used for their intended function(s).
Operational Simplicity	3.2	40 %	The extent to which a Strategy can be accomplished using simple, manageable operations.
Regulatory Impacts	3.3	40 %	The degree to which the Strategy uses existing permits. (FFA, STP, IWWP, etc.)
Cost	4.0	10 %	Life Cycle Costs including Total Project Cost, operational, and maintenance costs to implement the Strategy.
The Total Risk of Implementing a Strategy	5.0	20 %	Includes risks identified during the screening of individual ideas and additional risks identified for Strategies.

** The 2011 date was selected to show the number of HLW Tanks that will be emptied and would be available for start of closure activities in 2009.*

Table 9-2: Utility Functions

LEVEL 1 CRITERION	LEVEL 1 WEIGHT	LEVEL 2 CRITERION	LEVEL 2 WEIGHT	UTILITY FUNCTION	UTILITY FUNCTION VALUE
1.0 (Strategy exceeds available space baseline)	(.10)	None	N/A	<p><i>Note: Average annual excess calculated by summing the excess for each year in the 10-year period and then dividing the sum by 10.</i></p> <p>UF.1 – Largest increase beyond available space baseline requirements.</p> <p>UF.2 – {Linearly Interpolate between UF.1 and UF.3}.</p> <p>UF.3 – Meets available space baseline requirements.</p>	<p>100</p> <p>Interpolated</p> <p>0</p>
2.0 (Impact on site missions)	(.30)			See below.	
		2.1 (DWPF canister production)	(.50)	<p>UF.1 - Average DWPF production yields 200 canisters per year.</p> <p>UF.2 - Average DWPF production yields 125 canisters per year.</p> <p>UF.3 - Average DWPF production yields 0 canisters per year.</p>	<p>100</p> <p>62</p> <p>0</p>
		2.2 (HLW tank closure)	(.50)	<p>UF.1 - Most number of tanks closed (17).</p> <p>UF.2 - {Linearly Interpolate between UF.1 and UF.3}</p> <p>UF.3 - Five (5) tanks closed.</p> <p>UF.4 - {Linearly Interpolate between UF.3 and UF.5}</p> <p>UF.5 - Zero (0) tanks closed.</p>	<p>100</p> <p>Interpolated</p> <p>10</p> <p>Interpolated</p> <p>0</p>

Table 9-2: Utility Functions (Cont.)

LEVEL 1 CRITERION	LEVEL 1 WEIGHT	LEVEL 2 CRITERION	LEVEL 2 WEIGHT	UTILITY FUNCTION	UTILITY FUNCTION VALUE
3.0 (Compatibility with existing HLW processes)	(.30)	3.1 (use of existing facilities)	(.20)	See Below.	
				UF.1 - Existing facilities account for 100% of increase in available space.	100
				UF.2 - Existing facilities account for 80% of increase in available space.	80
				UF.3 - Existing facilities account for 60% of increase in available space.	60
				UF.4 - Existing facilities account for 40% of increase in available space.	40
				UF.5 - Existing facilities account for 20% of increase in available space.	20
				UF.6 - Existing facilities account for 0% of increase in available space.	0
		3.2 (operational simplicity)	(.40)	UF.1 - Design allows for simple, coordinated, straightforward operation.	100
				UF.2 - Design allows for manageable operation with minimal complexity (standard SRS practice).	60
				UF.3 - Design is highly coupled with minimum holdup, multiple parallel operations, fast dynamics, and process instability.	0
4.0 (Cost)	(.10)	None	N/A	UF.1 - Some discussions with Regulators may be required, but no permit or changes to permits required.	100
				UF.2 - Permit(s) change(s) required.	20
				UF.3 - New permit(s) required.	0
5.0 (Total risk of implementing a Strategy)	(.20)	None	N/A	UF.1 - Cost falls within \$0 – \$1.5 B.	100
				UF.2 - Cost falls within \$1.5 B to \$3.5 B	50
				UF.3 - Cost >\$3.5 B	0
5.0 (Total risk of implementing a Strategy)	(.20)	None	N/A	NOTE: Risk Score = 4 times the number of moderate risks + the number of low risks.	
				UF.1 - Strategy with lowest risk score calculated as noted above (S-1).	100
				UF.2 - {Linearly Interpolate between UF.1 and UF.3}.	Interpolated
				UF.3 - Strategy with highest risk score (S-124).	0

9.1.4 Strategy Ranking

The results from applying the MAUA to the 179 Strategies shown in Table 9-1 were determined and the 179 Strategies were then ranked in decreasing order of total score. A plot of these scores in decreasing order is shown on Figure 9-2. Reference 17 contains a detailed listing of each Strategy and the individual attribute scores for each of the weighted evaluation criteria that add up to the total scores represented in Figure 9-2. The total scores ranged from approximately 35 to 80 points.

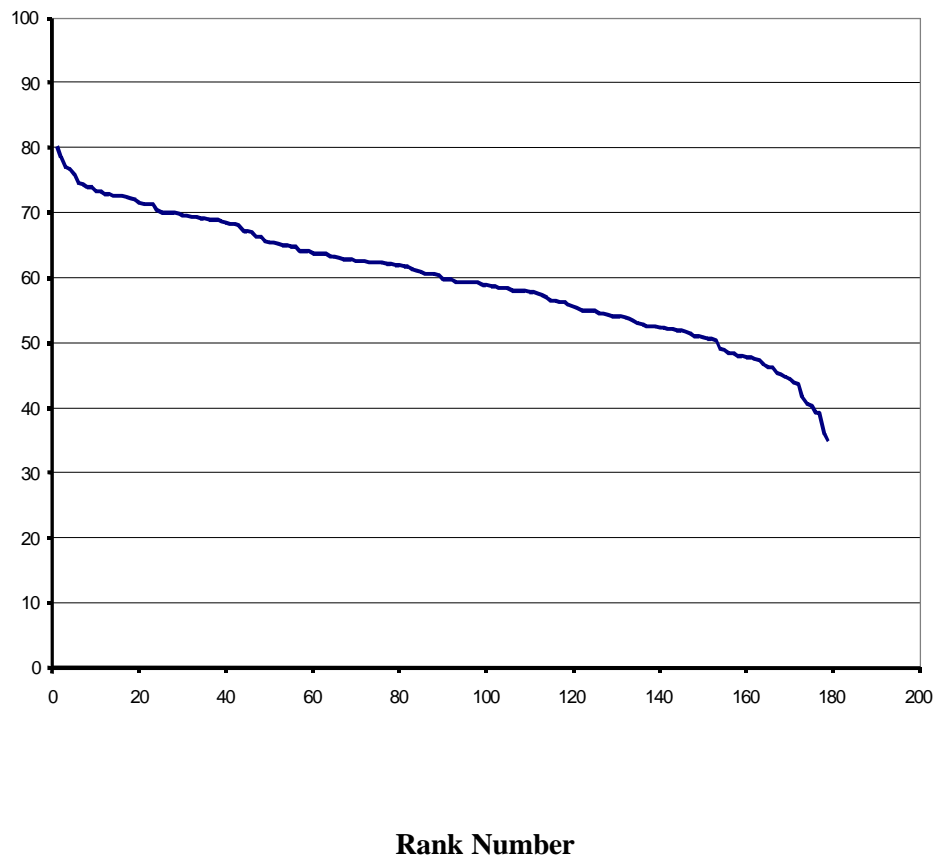


Figure 9-2: Ranked Scores of 179 Strategies

9.1.5 Selection of Top Eighteen (18) Strategies

As can be seen from Figure 9-2, there is no natural break in the data, so the SM Team selected the top 10 % or eighteen Strategies for further evaluation. These top eighteen Strategies are shown on Table 9-3 along with the individual attribute scores and their total score in descending order.

Table 9-3: Top 18 Strategies

Rank No.	Strategy No.	Intermediate List Ideas Included in Strategies	TIAS Exceeds Space Baseline Criterion 1.0	Impact on DWPF Canister Production Criterion 2.1	Impact on Tank Closures Criterion 2.2	Use of Existing HLW Facilities Criterion 3.1	Operational Simplicity Criterion 3.2	Regulatory Impacts Criterion 3.3	Cost Criterion 4.0	Risk Criterion 5.0	Total Score
1	S-101	10,17,22,1	6.26	15.00	15.00	3.29	8.95	6.58	10.00	15.29	80.37
2	S-104	10,17,18,1	4.17	15.00	15.00	3.34	8.21	5.09	10.00	17.65	78.46
3	S-105	10,17,21,1	4.87	15.00	15.00	3.19	9.01	4.69	10.00	15.29	77.07
4	S-107	10,17,69,1	4.87	15.00	15.00	2.84	9.01	4.69	10.00	15.29	76.72
5	S-13	10,17,22,11,18	4.79	15.00	10.09	5.32	10.08	7.91	10.00	12.65	75.84
6	S-59	10,17,22,16,18	5.43	15.00	10.09	5.88	7.65	7.73	10.00	12.94	74.71
7	S-17	10,17,22,11,21	5.50	15.00	10.09	5.15	11.00	7.45	10.00	10.29	74.48
8	S-25	10,17,22,11,69	5.50	15.00	10.09	4.75	11.00	7.45	10.00	10.29	74.08
9	S-15	10,17,22,14,18	4.79	15.00	10.09	5.21	9.18	7.91	10.00	11.76	73.95
10	S-60	10,17,22,16,21	6.14	15.00	10.09	5.71	8.55	7.28	10.00	10.59	73.35
11	S-143	10,22,21,11,1	6.03	15.00	15.00	3.00	10.12	3.80	10.00	10.29	73.24
12	S-62	10,17,22,16,69	6.14	15.00	10.09	5.31	8.55	7.28	10.00	10.59	72.95
13	S-151	10,22,69,11,1	6.03	15.00	15.00	2.69	10.12	3.80	10.00	10.29	72.93
14	S-106	10,17,72,1	5.58	15.00	13.77	3.34	8.21	5.09	10.00	11.76	72.77
15	S-156	10,22,21,16,1	6.67	15.00	15.00	3.46	8.24	3.73	10.00	10.59	72.69
16	S-19	10,17,22,14,21	5.50	15.00	10.09	5.04	10.10	7.45	10.00	9.41	72.59
17	S-158	10,22,69,16,1	6.67	15.00	15.00	3.16	8.24	3.73	10.00	10.59	72.39
18	S-27	10,17,22,14,69	5.50	15.00	10.09	4.64	10.10	7.45	10.00	9.41	72.19

9.1.6 Intermediate List Ideas Not Appearing in Top Eighteen Strategies

Table 9-4 lists the *Intermediate List* ideas that *did not appear* in the top eighteen Strategies and the SM Team judgment on why they were not components of the top Strategies.

**Table 9-4: Intermediate Ideas Eliminated from
179 Strategies During First Down-select**

IL No.	Title of Idea	Probable Basis For Not Making Top Eighteen
IL-3	Use Tanks 4 through 8 for HLW Concentrate Storage.	Requires reuse of older tanks and delays tank closure, which is contrary to major Site mission goals.
IL-4	Use Tanks 4 through 8 for Emergency Space.	Requires reuse of older tanks and delays tank closure, which is contrary to major Site mission goals.
IL-5	DWPF shutdown, FY-01 to FY-09	Impacts a major Site mission goal to vitrify HLW (200 canisters per year) and requires FFA to be renegotiated.
IL-6	Process salt cake with low Cs-137 into Class B Saltstone.	May not comply with DOE Order 435.1*; complexity of operation; uncertainty on permits and how to handle MST slurry from treatment; requires use of available tank space to process waste for disposal.
IL-7	Process salt cake with low Cs-137 into Class C Saltstone.	May not comply with DOE Order 435.1*; complexity of operation; uncertainty on permits and how to handle MST slurry from treatment; requires use of available tank space to process waste for disposal.
IL-12	Treat DWPF Recycle at Late Wash using Ion Exchange, sent to ETF.	Complexity of operations based on ion exchange; handling of spent resin.
IL-15	Treat DWPF Recycle in a Waste Tank and Portable Unit to meet WAC for Z Area.	Complexity of operation; uncertainty on how to handle MST; reuses Type IV tanks that are now used to handle DWPF recycle receipts.
IL-24	Reduce DWPF production to 125 cans per year.	Impacts a major site mission goal to average 200 canisters per year production; requires FFA to be renegotiated.

* DOE Order 435.1 specifies waste planned for disposal as LLW is to be treated to reduce the concentration of radioactive contaminants to “As Low As Reasonably Achievable (ALARA)” using technically and economically feasible processes. Because demonstrated technology for Cs-137 removal is available, direct disposal of salt solution as a grout without treatment to remove Cs-137 may be in violation of this DOE Order.

9.1.7 Effect of Ideas on Strategy Scores

Figure 9-3 shows the average Strategy scores of all Strategies containing a particular idea. Mutually exclusive ideas are grouped together to show which ideas score highest in these groups. This metric indicates how a particular idea interacts with Strategies. Ideas that tend to pull Strategy scores up will have a higher average score, whereas ideas that tend to pull Strategy scores down will have lower average scores. Note that the eight ideas in Table 9-4 all rank low in this comparison, which further supports their absence from the top 18 Strategies.

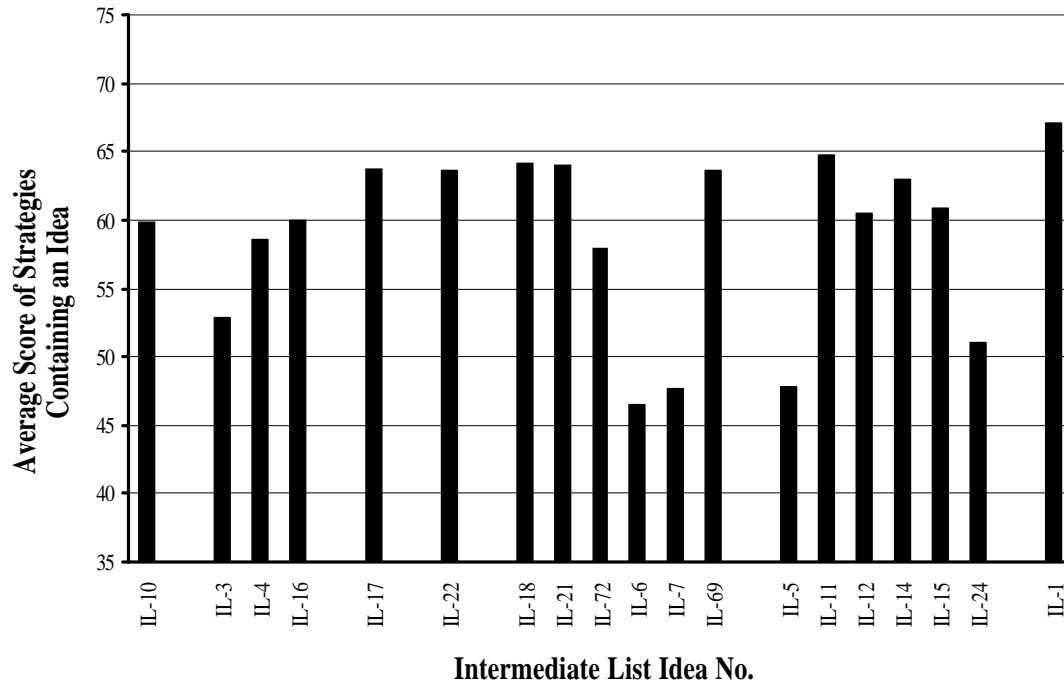


Figure 9-3: Effect of Ideas on Strategy Scores

9.2 Selection of Top Four Strategies

The down-selection process used to reduce the number of Strategies from eighteen to the *Short List* of four Strategies is described in this section.

The eighteen Strategies (Table 9-3) have both common and unique combinations of ideas. *Intermediate List* idea IL-10 (Evaporate Backlog Waste) appears in each of the eighteen Strategies and is not useful as a discriminator for further down-selection.

The SM Team further recognized that several subsets of the eighteen Strategies had very similar idea combinations. The only differences within these subsets were functionally equivalent ideas addressing specific aspects of a Strategy, i.e., handling of DWPF recycle, handling of ETF bottoms and addressing the issue of Emergency Space.

9.2.1 Assessment of Strengths and Weakness of Strategies

A subset of Strategies was assigned to a SM Team member to act as a sponsor. The SM Team member prepared detailed strengths and weaknesses of each Strategy within an assigned subset. The sponsor also recommended the preferred Strategy within the assigned subset.

After completing the individual sponsor reviews, a unified set of strengths and weaknesses for each Strategy was constructed and the SM Team collectively reviewed and discussed the strengths, weaknesses and subset recommendations for consensus. The strengths and weaknesses identified for each of the eighteen Strategies are discussed below in their rank order from Table 9-3.

Strategy S-101 -- Rank Value 1

Consists of ideas:

- 10 Evaporate Backlog Waste
- 17 Reduce Emergency Space to 1300k Gallons
- 22 Allow TPB in Tank 49 to Decompose (HLW to Tank 49)
- 1 Build New HLW Tanks

Advantages	Disadvantages
<ul style="list-style-type: none"> Low implementation cost in early years. Average excess space is high. Retires the most Tanks (17). Provides option to accelerate tank closures, if funded (4 more tanks available than HLWSP Rev. 10 Planning Case). Does not reuse Type I tanks, so they are available for closure after emptying. After processing Tank 50 material in FY04, Z Area is not required to operate until FY09 when Tank 50 is again full of ETF bottoms. 	<ul style="list-style-type: none"> Overall implementation cost is high. Higher risk associated with building 4 HLW tanks by 2007 due to regulatory or intervenor delays. Reduces Emergency Space in early years to meet space need. Increases operational complexity in dealing with emergency space. Constructs 4 HLW tanks that must be closed. Tank 49 space may not be gained when needed if material does not decompose as expected. Vulnerable to a "space shortfall" in the event of a tank leak until new tanks are available (2007).

Strategy S-104 -- Rank Value 2

Consists of ideas:

- 10 Evaporate Backlog Waste
- 17 Reduce Emergency Space to 1300 K-Gal
- 18 ETF Bottoms to Z Area (HLW to Tank 50)
- 1 Build New HLW Tanks

Advantages	Disadvantages
<ul style="list-style-type: none"> Retires the most Tanks (17). Provides option to accelerate tank closures, if funded (4 more tanks available than HLWSP Rev. 10 Planning Case). Does not reuse Type I tanks, so they are available for closure after emptying. Most TIAS for post 2009 needs. Low number of risks Interfaces broken between the ETF and the Tank Farm and between Z Area and the Tank Farm, eliminating interaction with the Tank Farm to operate the ETF evaporator or Z Area. 	<ul style="list-style-type: none"> Overall implementation cost is high Higher risk of regulatory or intervenor delays associated with building 4 HLW tanks by 2007. Constructs 4 HLW tanks that must be closed. Requires continuous staffing of Z Area starting in FY05 to handle ETF bottoms. Reduces Emergency Space in early years to meet space needs. Increases operational complexity in dealing with emergency space. Vulnerable to a "space shortfall" in the event of a tank leak until new tanks are available (2007).

Strategy S-105 -- Rank Value 3

Consists of ideas:

- 10 Evaporate Backlog Waste
- 17 Reduce Emergency Space to 1300 K-Gal
- 21 New Tank for ETF Bottoms (HLW to Tank 50)
- 1 Build New HLW Tanks

Advantages	Disadvantages
<ul style="list-style-type: none"> Provides 6500 K-gal of new HLW storage space from 4 new tanks and reclaims Tank 50. Interfaces broken between the ETF and the Tank Farm and between Z Area and the Tank Farm, eliminating interaction with the Tank Farm to operate the ETF evaporator or Z Area. Provides about 1000 K-gal "cushion" for continued operation beyond 2009, if needed. Retires the most Tanks (17). Provides option to accelerate tank closures, if funded (4 more tanks available than HLWSP Rev. 10 Planning Case). Does not reuse Type I tanks, so they are available for closure after emptying. Tank 49 is still available (in reserve) if needed, due to changing missions or delays in other projects ("new tanks for this Strategy" or "salt treatment" facility). Allows for efficient use of Solid Waste resources. 	<ul style="list-style-type: none"> Reduces Emergency Space in early years to meet space need. Increases operational complexity in dealing with emergency space. Vulnerable to a "space shortfall" in the event of a tank leak until the new tanks are on-line (2007). Requires intermittent operation of Z Area, but with more efficient use of Solid Waste resources. Two projects must be funded early – New tanks for HLW, a new tank for ETF bottoms. Overall implementation cost is high. Higher risk of regulatory or intervenor delays associated with building 4 HLW tanks by 2007. Constructs 4 HLW tanks that must be closed. Vulnerable to a "space shortfall" in the event of a tank leak until new tanks are available (2007).

Strategy S-107 -- Rank Value 4

Consists of ideas:

- 10 Evaporate Backlog Waste
- 17 Reduce Emergency Space to 1300 K-Gal
- 69 Use Tanks in Reactor Areas for ETF Bottoms (HLW to Tank 50)
- 1 Build New HLW Tanks

Advantages	Disadvantages
<ul style="list-style-type: none"> Interfaces broken between the ETF and the Tank Farm and between Z Area and the Tank Farm, eliminating interaction with the Tank Farm to operate the ETF evaporator or Z Area. After processing Tank 50 material in FY04, Z Area not required to operate until FY09 when Salt Processing starts. Retires the most Tanks (17). Provides option to accelerate tank closures, if funded (4 more tanks available than HLWSP Rev. 10 Planning Case). Does not reuse Type I tanks, so they are available for closure after emptying. Tank 49 remains in reserve if needed for changing missions or delays in projects ("new tanks for this Strategy" or "salt treatment" facility). Allows for efficient use of Solid Waste resources. 	<ul style="list-style-type: none"> Overall implementation cost is high Higher risk of regulatory or intervenor delays associated with building 4 HLW tanks by 2007. Constructs 4 HLW tanks that must be closed. Barely meets space need until new tanks are operational. Moving 500,000-gal tanks from Reactor Areas to store ETF Bottoms poses higher risk because tanks may not be structurally sound after move. Alternatively, RCRA permits and a transport vehicle would be needed to move waste to the tanks if they stay in Reactor areas. Vulnerable to a "space shortfall" in the event of a tank leak until new tanks are available (2007).

Strategy S-13 -- Rank Value 5

Consists of ideas:

- 10 Evaporate Backlog Waste
- 17 Reduce Emergency Space to 1300 K-Gal
- 22 Allow TPB in Tank 49 to Decompose (HLW to Tank 49)
- 11 Evaporator in DWPF Salt Cell for DWPF Recycle
- 18 ETF Bottoms to Z Area (HLW to Tank 50)

Advantages	Disadvantages
<ul style="list-style-type: none"> Does not impact tank closures (13) in HLWSP Rev. 10 Planning Case, if funded. Interface broken between DWPF and Tank Farm for DWPF recycle. Outage planning is simplified. Intermediate number of risks. Lower overall cost. Does not reuse Type I tanks, so they are available for closure after emptying. Interfaces broken between the ETF and the Tank Farm and between Z Area and the Tank Farm, eliminating interaction with the Tank Farm to operate the ETF evaporator or Z Area. 	<ul style="list-style-type: none"> Installs an evaporator in the DWPF Salt Cell; acid hydrolysis process must either be done elsewhere, if needed as part of future operations (depends on Alt. Salt process chosen) or reinstalled in 2009, eliminating evaporator for DWPF recycle. Requires continuous staffing of Z Area starting in FY05 to handle small ETF concentrate stream Reduces Emergency Space in early years to meet space needs. Increases operational complexity in dealing with emergency space. Tank 49 space may not be gained when needed if material does not decompose as expected.

Strategy S-59 -- Rank Value 6

Consists of ideas:

- 10 Evaporate Backlog Waste
- 17 Reduce Emergency Space to 1300k Gallons
- 22 Allow TPB in Tank 49 to Decompose (HLW to Tank 49)
- 16 Small Tanks for Emergency Space
- 18 ETF Bottoms to Z Area (HLW to Tank 50)

Advantages	Disadvantages
<ul style="list-style-type: none"> Average excess space is good Does not impact tank closures (13) in HLWSP Rev. 10 Planning Case, if funded. Does not reuse Type I tanks, so they are available for closure after emptying. Interfaces broken between the ETF and the Tank Farm and between Z Area and the Tank Farm, eliminating interaction with the Tank Farm to operate the ETF evaporator or Z Area. 	<ul style="list-style-type: none"> Overall implementation cost is high. Reduces Emergency Space early to meet space needs; increases operational complexity in dealing with emergency space. Requires continuous staffing of Z Area starting in FY05 to handle ETF bottoms stream. Although used for emergency space, higher risk of regulatory or intervenor delay is associated with building 42 small tanks by 2007. Operational complexity to survey and maintain 42 tanks (likely located away from Tank Farm). Constructs 42 HLW tanks that must be closed. Tank 49 space may not be gained when needed if material does not decompose as expected.

Strategy S-17 -- Rank Value 7

Consists of ideas:

- 10 Evaporate Backlog Waste
- 17 Reduce Emergency Space to 1300 K-Gal
- 22 Allow TPB in Tank 49 to Decompose (HLW to Tank 49)
- 11 Evaporator in DWPF Salt Cell for DWPF Recycle
- 21 New Tank for ETF Bottoms (HLW to Tank 50)

Advantages	Disadvantages
<ul style="list-style-type: none"> Does not impact tank closures (13) in HLWSP Rev. 10 Planning Case, if funded. Interface broken between DWPF and Tank Farm for DWPF recycle. Outage planning is simplified. Intermediate number of risks Does not reuse Type I tanks, so they are available for closure after emptying. Provides excess space above ASB, especially in the early years (through 2007), which reduces the risk of delays in feed preparation for DWPF (ESP processing). Interfaces broken between the ETF and the Tank Farm and between Z Area and the Tank Farm, eliminating interaction with the Tank Farm to operate the ETF evaporator or Z Area. Allows for efficient use of Solid Waste resources. 	<ul style="list-style-type: none"> Intermediate Costs Reduces Emergency Space in early years to meet space needs. Increases operational complexity in dealing with emergency space. Requires intermittent operation of Z Area, but with more efficient use of Solid Waste resources. Installs an evaporator in the DWPF Salt Cell; acid hydrolysis process must either be done elsewhere, if needed as part of future operations (depends on Alt. Salt process chosen) or reinstalled in 2009, eliminating evaporator for DWPF recycle. Tank 49 space may not be gained when needed if material does not decompose as expected.

Strategy S-25 -- Rank Value 8

Consists of ideas:

- 10 Evaporate Backlog Waste
- 17 Reduce Emergency Space to 1300 K-Gal
- 22 Allow TPB in Tank 49 to Decompose (HLW to Tank 49)
- 11 Evaporator in DWPF Salt Cell for DWPF Recycle
- 69 Use Tanks in Reactor Areas for ETF Bottoms (HLW to Tank 50)

Advantages	Disadvantages
<ul style="list-style-type: none"> Provides ~2200 K-gal of new HLW storage space from Tank 49 and Tank 50. Interfaces broken between the ETF and the Tank Farm and between Z Area and the Tank Farm, eliminating interaction with the Tank Farm to operate the ETF evaporator or Z Area. After processing Tank 50 material in FY04, Z Area not required to operate until FY09 when Salt Processing starts. Provides excess space above ASB, especially in the early years (through 2007), which reduces the risk of delays in feed preparation for DWPF (ESP processing). Does not impact tank closures (13) in HLWSP Rev. 10 Planning Case, if funded. Does not reuse Type I tanks, so they are 	<ul style="list-style-type: none"> Reduces Emergency Space in early years to meet space needs. Increases operational complexity in dealing with emergency space. Installs an evaporator in the DWPF Salt Cell; acid hydrolysis process must either be done elsewhere, if needed as part of future operations (depends on Alt. Salt process chosen) or reinstalled in 2009, eliminating evaporator for DWPF recycle. Moving 500,000-gal tanks from Reactor Areas to store ETF Bottoms poses higher risk because tanks may not be structurally sound after move. Alternatively, RCRA permits and a transport vehicle would be needed to move waste to the tanks if they stay in Reactor areas. Minimal excess space above ASB beyond

<p>available for closure after emptying.</p> <ul style="list-style-type: none"> Several minor projects to achieve, but no major project such as building new waste tanks needed. Interface broken between DWPF and Tank Farm for DWPF recycle. Outage planning is simplified. Allows for efficient use of Solid Waste resources. 	<p>2009; if salt cell evaporator is replaced for acid hydrolysis equipment then space is further reduced (~200 K-gal/yr).</p> <ul style="list-style-type: none"> Tank 49 space may not be gained when needed if material does not decompose as expected.
---	---

Strategy S-15 -- Rank Value 9

Consists of ideas:

- 10 Evaporate Backlog Waste
- 17 Reduce Emergency Space to 1300 K-Gal
- 22 Allow TPB in Tank 49 to Decompose (HLW to Tank 49)
- 14 Evaporator in LWF for DWPF Recycle
- 18 ETF Bottoms to Z Area (HLW to Tank 50)

Advantages	Disadvantages
<ul style="list-style-type: none"> Exceeds ASB through 2005 without LWF Evaporator; a one-year delay can be tolerated. Does not impact tank closures (13) in HLWSP Rev. 10 Planning Case, if funded. Does not reuse Type I tanks, so they are available for closure after emptying. Interfaces broken between the ETF and the Tank Farm and between Z Area and the Tank Farm, eliminating interaction with the Tank Farm to operate the ETF evaporator or Z Area. 	<ul style="list-style-type: none"> Early years cost requirements for LW Evaporator Project Requires continuous staffing of Z Area starting in FY05 to handle small ETF concentrate stream Prevents use of LWF for pilot scale facility for alternative salt process. Tank 49 space may not be gained when needed if material does not decompose as expected.

Strategy S-60 -- Rank Value 10

Consists of ideas:

- 10 Evaporate Backlog Waste
- 17 Reduce Emergency Space to 1300k gallons
- 22 Allow TPB in Tank 49 to Decompose (HLW to Tank 49)
- 16 Small Tanks for Emergency Space
- 21 New Tank for ETF Bottoms (HLW to Tank 50)

Advantages	Disadvantages
<ul style="list-style-type: none"> Average excess space is good Allows for efficient use of Solid Waste resources. Does not impact tank closures (13) in HLWSP Rev. 10 Planning Case, if funded. Does not reuse Type I tanks, so they are available for closure after emptying. Interfaces broken between the ETF and the Tank Farm and between Z Area and the Tank Farm, eliminating interaction with the Tank Farm to operate the ETF evaporator or Z Area. 	<ul style="list-style-type: none"> Overall implementation cost is high Reduces Emergency Space in early years to meet space needs. Increases operational complexity in dealing with emergency space. Although used for emergency space, higher risk of regulatory or intervenor delays is associated with building 42 small tanks by 2007. Operational complexity to survey and maintain 42 tanks (likely located away from Tank Farm). Tank 49 space may not be gained when needed if material does not decompose as expected. Requires intermittent operation of Z Area, but with more efficient use of Solid Waste resources.

Strategy S-143 -- Rank Value 11

Consists of ideas:

- 10 Evaporate Backlog Waste
- 22 Allow TPB in Tank 49 to Decompose (HLE to Tank 49)
- 21 New Tank for ETF Bottoms (HLW to Tank 50)
- 11 Evaporator in DWPF Salt Cell for DWPF Recycle
- 1 Build New HLW Tanks

Advantages	Disadvantages
<ul style="list-style-type: none"> Interface broken between DWPF and Tank Farm for DWPF recycle. Outage planning is simplified. Retires the most Tanks (17). Provides option to accelerate tank closures, if funded (4 more tanks available than HLWSP Rev. 10 Planning Case). Does not reuse Type I tanks, so they are available for closure after emptying. Interfaces broken between the ETF and the Tank Farm and between Z Area and the Tank Farm, eliminating interaction with the Tank Farm to operate the ETF evaporator or Z Area. Does not reduce Emergency Space. Allows for efficient use of Solid Waste resources. 	<ul style="list-style-type: none"> Overall implementation cost high Average excess not as high as other Strategies (especially in early years) Installs an evaporator in the DWPF Salt Cell; acid hydrolysis process must either be done elsewhere, if needed as part of future operations (depends on Alt. Salt process chosen) or reinstalled in 2009, eliminating evaporator for DWPF recycle. Higher risk of regulatory or intervenor delays associated with building 4 HLW tanks by 2007. Constructs 4 HLW tanks that must be closed. Tank 49 space may not be gained when needed if material does not decompose as expected. Requires intermittent operation of Z Area, but with more efficient use of Solid Waste resources. Vulnerable to a "space shortfall" in the event of a tank leak until the new tanks are available (2007).

Strategy S-62 -- Rank Value 12

Consists of ideas:

- 10 Evaporate Backlog Waste
- 17 Reduce Emergency Space to 1300 K-Gal
- 22 Allow TPB in Tank 49 to Decompose (HLW to Tank 49)
- 16 Small Tanks for Emergency Space
- 69 Use Tanks in Reactor Areas for ETF Bottoms (HLW to Tank 50)

Advantages	Disadvantages
<ul style="list-style-type: none"> Does not impact tank closures (13) in HLWSP Rev. 10 Planning Case, if funded. Intermediate number of risks Does not reuse Type I tanks, so they are available for closure after emptying. Interfaces broken between the ETF and the Tank Farm and between Z Area and the Tank Farm, eliminating interaction with the Tank Farm to operate the ETF evaporator or Z Area. After processing Tank 50 material in FY04, Z Area not required to operate until FY09 when Salt Processing starts. Allows for efficient use of Solid Waste resources. 	<ul style="list-style-type: none"> Cost = \$100M in 2003; LCC of \$553M Although used for emergency space, higher risk of regulatory or intervenor delays is associated with building 42 small tanks by 2007. Constructs 42 HLW tanks that must be closed. Reduces Emergency Space in early years to meet space needs. Increased operational complexity in dealing with emergency space. Moving 500,000-gal tanks from Reactor Areas to store ETF Bottoms poses higher risk because tanks may not be structurally sound after move. Alternatively, RCRA permits and a transport vehicle would be needed to move waste to the tanks if they stay in Reactor areas. Tank 49 space may not be gained when needed if material does not decompose as expected.

Strategy S-151 -- Rank Value 13

Consists of ideas:

- 10 Evaporate Backlog Waste
- 22 Allow TPB in Tank 49 to Decompose (HLW to Tank 49)
- 69 Use Tanks in Reactor Areas for ETF Bottoms (HLW to Tank 50)
- 11 Evaporator in DWPF Salt Cell for DWPF Recycle
- 1 Build New HLW Tanks

Advantages	Disadvantages
<ul style="list-style-type: none"> Does not reduce Emergency Space. Provides 6500 K-gal of new HLW storage space from 4 new tanks and reclaiming Tank 50. Interfaces broken between ETF and the Tank Farm and between Z Area and the Tank Farm, eliminating interaction with the Tank Farm to operate the ETF evaporator or Z Area. After processing Tank 50 material in FY04, Z Area not required to operate until FY09 when Salt Processing starts. Provides about 1000 K-gal “cushion” for continued operation beyond 2009, if needed. Retires the most Tanks (17). Provides option to accelerate tank closures, if funded (4 more tanks available than HLWSP Rev. 10 Planning Case). Does not reuse Type I tanks, so they are available for closure after emptying. Interface broken between DWPF and Tank Farm for DWPF recycle. Outage planning is simplified. Allows for efficient use of Solid Waste resources. 	<ul style="list-style-type: none"> Three projects must be funded early – New tanks for HLW; move reactor tanks; salt cell evaporator. Installs an evaporator in the DWPF Salt Cell; acid hydrolysis process must either be done elsewhere, if needed as part of future operations (depends on Alt. Salt process chosen) or reinstalled in 2009, eliminating evaporator for DWPF recycle. Moving 500,000-gal tanks from Reactor Areas to store ETF Bottoms poses higher risk because tanks may not be structurally sound after move. Alternatively, RCRA permits and a transport vehicle would be needed to move waste to the tanks if they stay in Reactor areas. Overall implementation cost is high. Higher risk of regulatory or intervenor delays associated with building 4 HLW tanks by 2007. Four additional HLW tanks to close. Tank 49 space may not be gained when needed if material does not decompose as expected.

Strategy S-106 -- Rank Value 14

Consists of ideas:

- 10 Evaporate Backlog Waste
- 17 Reduce Emergency Space to 1300 K-Gal
- 72 Use Type IV tank for ETF Bottoms
- 1 Build New HLW Tanks

Advantages	Disadvantages
<ul style="list-style-type: none"> Retires the most Tanks (17). Provides option to accelerate tank closures, if funded (4 more tanks available than HLWSP Rev. 10 Planning Case). After processing Tank 50 material in FY04, Z Area not required to operate until FY09 when Salt Processing starts. Utilizes existing facilities. Does not reuse Type I tanks, so they are available for closure after emptying. Tank 49 is still available (in reserve) if needed, due to changing missions or delays in other projects (“new tanks for this Strategy” or “salt treatment” facility). 	<ul style="list-style-type: none"> Overall implementation cost is high Higher risk of regulatory or intervenor delays associated with building 4 HLW tanks by 2007. Constructs 4 HLW tanks that must be closed. Vulnerable to a “space shortfall” in the event of a tank leak until the new tanks are available (2007). Puts waste ready for final treatment and disposal (ETF bottoms) into HLW tanks; waste will require further treatment before disposal. Would impact use of Type IV tanks for storage of spent washes from ESP.

Strategy S-156 -- Rank Value 15

Consists of ideas:

- 10 Evaporate Backlog Waste
- 22 Allow TPB in Tank 49 to Decompose (HLW to Tank 49)
- 21 New Tank for ETF Bottoms (HLW to Tank 50)
- 16 Small Tanks for Emergency Space
- 1 Build New HLW Tanks

Advantages	Disadvantages
<ul style="list-style-type: none"> Allows for efficient use of Solid Waste resources. Does not impact tank closures (13) in HLWSP Rev. 10 Planning Case, if funded. Does not reuse Type I tanks, so they are available for closure after emptying. Interfaces broken between the ETF and the Tank Farm and between Z Area and the Tank Farm, eliminating interaction with the Tank Farm to operate the ETF evaporator or Z Area. Does not reduce Emergency Space. 	<ul style="list-style-type: none"> Overall implementation cost very, very high Higher risk of regulatory or intervenor delays associated with building 4 HLW tanks by 2007. Although used for emergency space, higher risk of regulatory or intervenor delays associated with building 42 small tanks by 2007. Constructs 46 HLW tanks that must be closed. Operational complexity to survey and maintain 46 more tanks (likely located away from Tank Farm). Tank 49 space may not be gained when needed if material does not decompose as expected. Requires intermittent operation of Z Area, but with more efficient use of Solid Waste resources.

Strategy S-19 -- Rank Value 16

Consists of ideas:

- 10 Evaporate Backlog Waste
- 17 Reduce Emergency Space to 1300 K-Gal
- 22 Allow TPB in Tank 49 to Decompose (HLW to Tank 49)
- 14 Evaporator in LWF for DWPF Recycle
- 21 New Tank for ETF Bottoms (HLW to Tank 50)

Advantages	Disadvantages
<ul style="list-style-type: none"> Provides ~2200 K-gal of new HLW storage space from Tank 49 and Tank 50. Interfaces broken between the ETF and the Tank Farm and between Z Area and the Tank Farm, eliminating interaction with the Tank Farm to operate the ETF evaporator or Z Area. Does not impact tank closures (13) in HLWSP Rev. 10 Planning Case, if funded. Does not reuse Type I tanks, so they are available for closure after emptying. Several minor projects needed, but no major project such as building new waste tanks needed. Provides excess space over the entire time period, which would reduce the risk of delays in feed preparation for DWPF (ESP processing). Retains salt cell for its intended use. Interface broken between DWPF and Tank Farm for DWPF recycle. Outage planning is simplified. Allows for efficient use of Solid Waste resources. 	<ul style="list-style-type: none"> Minimal space cushion beyond 2009. Prevents use of LWF for pilot scale facility for alternative salt process. Reduces Emergency Space in early years to meet space needs. Increases operational complexity in dealing with emergency space. Tank 49 space may not be gained when needed if material does not decompose as expected. Requires intermittent operation of Z Area, but with more efficient use of Solid Waste resources.

Strategy S-158 -- Rank Value 17

Consists of ideas:

- 10 Evaporate Backlog Waste
- 22 Allow TPB in Tank 49 to Decompose (HLW to Tank 49)
- 69 Use Tanks in Reactor Areas for ETF Bottoms (HLW to Tank 50)
- 16 Small Tanks for Emergency Space
- 1 Build New HLW Tanks

Advantages	Disadvantages
<ul style="list-style-type: none"> Allows for efficient use of Solid Waste resources. Does not impact tank closures (13) in HLWSP Rev. 10 Planning Case, if funded. Does not reuse Type I tanks, so they are available for closure after emptying. Interfaces broken between the ETF and the Tank Farm and between Z Area and the Tank Farm, eliminating interaction with the Tank Farm to operate the ETF evaporator or Z Area. After processing Tank 50 material in FY04, Z Area not required to operate until FY09 when Salt Processing starts. Does not reduce Emergency Space. 	<ul style="list-style-type: none"> Overall implementation cost very, very high. Higher risk of regulatory or intervenor delays associated with building 4 HLW tanks by 2007. Although used for emergency space, higher risk of regulatory or intervenor delay is associated with building 42 small tanks by 2007. Operationally complex to survey and maintain 46 more tanks (likely located away from Tank Farm). Constructs 46 HLW tanks that must be closed. Tank 49 space may not be gained when needed if material does not decompose as expected. After moving, the 500,000-gal tanks from Reactor Areas used to store ETF Bottoms pose higher risk because tanks may not be structurally sound after move. Alternatively, RCRA permits and a transport vehicle would be needed to move waste to the tanks if they stay in Reactor areas.

Strategy S-27 -- Rank Value 18

Consists of ideas:

- 10 Evaporate Backlog Waste
- 17 Reduce Emergency Space to 1300 K-Gal
- 22 Allow TPB in Tank 49 to Decompose (HLW to Tank 49)
- 14 Evaporator in LWF for DWPF Recycle
- 69 Use Tanks in Reactor Areas for ETF Bottoms (HLW to Tank 50)

Advantages	Disadvantages
<ul style="list-style-type: none"> Does not impact tank closures (13) in HLWSP Rev. 10 Planning Case, if funded. Interface broken between DWPF and Tank Farm for DWPF recycle. Outage planning is simplified. Intermediate number of risks. Does not reduce Emergency Space. Does not reuse Type I tanks after emptying, so they are available for closure. Interfaces broken between the ETF and the Tank Farm and between Z Area and the Tank Farm, eliminating interaction with the Tank Farm to operate the ETF evaporator or Z Area. After processing Tank 50 material in FY04, Z Area not required to operate until FY09 when Salt Processing starts. Allows for efficient use of Solid Waste resources. 	<ul style="list-style-type: none"> Intermediate Costs Moving 500,000-gal tanks from Reactor Areas to store ETF Bottoms poses higher risk because tanks may not be structurally sound after move. Alternatively, RCRA permits and a transport vehicle would be needed to move waste to the tanks if they stay in Reactor areas. Prevents use of LWF for pilot scale facility for Alternative Salt Process. Reduces Emergency Space in early years to meet space needs. Increases operational complexity in dealing with emergency space. Vulnerable to a "space shortfall" in the event of a tank leak early in the period. Tank 49 space may not be gained when needed if material does not decompose as expected.

The SM Team then used the above strength and weakness information, input from Stakeholders, expertise and judgement to select a preferred *Intermediate List* idea from a group of functionally equivalent ideas that appeared in the top 18 Strategies, as shown in Table 9-5.

Table 9-5: Comparison of Functionally Equivalent Ideas

Waste Stream or Issue to Manage	Equivalent <i>Intermediate List</i> Ideas that Manage a Waste Stream or Issue
Handling of DWPF Recycle	IL-11, IL-14
Handling of ETF Bottoms	IL-21, IL-18, IL-69, IL-72
Handling of Emergency Space	IL-17, IL-16

A comparison was then made between functionally equivalent Strategies to select those Strategies that contained only the favored ideas. Elimination of Strategies containing less favorable ideas (14, 16, 18, 69 and 72) reduced the number of Strategies from eighteen to four. Details of these down-selections are described below.

9.2.2 Handling of DWPF Recycle

Intermediate List idea IL-11 was considered more favorable for handling the DWPF recycle stream than IL-14 because it consistently ranked higher when Strategies that differed only in these two ideas were compared. By installing an Evaporator for the DWPF recycle stream in the Salt Cell (IL-11), the interface between DWPF and the Tank Farm to handle the DWPF recycle stream is eliminated. However, a new interface would be created between DWPF and ETF by extending the existing line that now leads from the OWST to the CIF. This line would be extended to the H-Area Process Sewer line behind the H-Canyon Building, which presently connects to ETF. If an Evaporator were installed in the LWF instead of the Salt Cell, multiple waste transfers between the DWPF to the LWF would be required to evaporate the waste and the bottoms must then be returned to the DWPF canyon. The overheads would still be sent to the ETF, but the use of the LWF would require these transfers to be made via the Tank Farm.

Three pairs of Strategies from the top eighteen Strategies are shown in Table 9-6 that differ only in how the DWPF recycle stream is managed.

Table 9-6: Down-Selection for Managing DWPF Recycle

Waste Stream or Issue to Manage	Strategy Rank	Strategy No.	Intermediate List Ideas Used
DWPF Recycle	5	S-13	10,17, 22, 11 ,18
DWPF Recycle	9	S-15	10,17, 22, 14 ,18
DWPF Recycle	7	S-17	10,17, 22, 11 ,21
DWPF Recycle	16	S-19	10,17, 22, 14 ,21
DWPF Recycle	8	S-25	10,17, 22, 11 ,69
DWPF Recycle	18	S-27	10,17, 22, 14 ,69

In this down-selection, three Strategies (S-15, S-19 and S-27) that contained *Intermediate List* idea IL-14 were eliminated from the list of the top eighteen Strategies, reducing the list to fifteen.

9.2.3 Handling of ETF Bottoms

Intermediate List idea IL-72 consistently ranked lower than IL-18, IL-21 or IL-69 among the Strategies that differed only in the idea selected to handle ETF bottoms. IL-18, IL-21, and IL-69 were ranked very close, with IL-18 being slightly better than the other two. Therefore, it is difficult to select an idea based on HLW needs only. However, discussions with Solid Waste Personnel revealed that a separate tank for ETF bottoms was preferred because of improved efficiency of operations in Solid Waste Facilities. An additional tank would allow Solid Waste to reduce the frequency of intermittent operations in Z Area. Accordingly, *Intermediate List* idea IL-21 was selected as the most favorable idea from this group of ideas that handle ETF bottoms. Five groups of Strategies from the remaining fifteen Strategies are shown in Table 9-7 that differ only in how the ETF Bottoms stream is managed.

Table 9-7: Down-Selection for Managing ETF Bottoms

Waste Stream or Issue to Manage	Strategy Rank	Strategy No.	Intermediate List Ideas Used
ETF Bottoms	2	S-104	10,17, 18 ,1
ETF Bottoms	3	S-105	10,17, 21 ,1
ETF Bottoms	4	S-107	10,17, 69 ,1
ETF Bottoms	14	S-106	10,17, 72 ,1
ETF Bottoms	5	S-13	10,17, 22,11, 18
ETF Bottoms	7	S-17	10,17, 22,11, 21
ETF Bottoms	8	S-25	10,17, 22,11, 69
ETF Bottoms	6	S-59	10,17,22,16, 18
ETF Bottoms	10	S-60	10,17,22,16, 21
ETF Bottoms	12	S-62	10,17,22,16, 69
ETF Bottoms	11	S-143	10,22, 21 ,11,1
ETF Bottoms	13	S-151	10,22, 69 ,11,1
ETF Bottoms	15	S-156	10,22, 21 ,16,1
ETF Bottoms	17	S-158	10,22, 69 ,16,1

Nine Strategies (S-104, S-107, S-106, S-13, S-25, S-59, S-62, S-151 and S-158) containing *Intermediate List* ideas IL-18, IL-69 or IL-72 were eliminated, reducing the list of Strategies to six.

9.2.4 Eliminating the Use of Small Tanks for Emergency Space

The six remaining Strategies shown in Table 9-8 were then examined for the handling of Emergency Space. Of the six remaining Strategies, four would reduce the 2600 K-gal of Emergency Space now specified by operations to 1300 K-gal specified in the Authorization Basis for the Tank Farm. Two contain *Intermediate List* idea IL-16, which proposes to construct 42 smaller tanks to provide emergency space, thus eliminating the need to reduce Emergency Space. One of the Strategies (S-143) does not rely on any changes to the Emergency Space to provide the needed space.

Table 9-8: Emergency Space Down-Selection

Waste Stream or Issue to Manage	Strategy Rank	Strategy No.	Intermediate List Ideas Used
Emergency Space	1	S-101	10,17,22,1
Emergency Space	3	S-105	10,17,21,1
Emergency Space	7	S-17	10,17, 22,11,21
Emergency Space	10	S-60	10, 17 ,22, 16 ,21
Emergency Space	11	S-143	10,22,21,11,1
Emergency Space	15	S-158	10,22,21, 16 ,1

Upon closer examination, neither of the Strategies containing IL-16 yielded a logical solution to obtain the needed space. Strategy S-10 proposes to construct 42 small tanks for use as Emergency space while simultaneously reducing available Emergency Space to the AB Limit of 1300 K-gal. Constructing tanks for Emergency Space while also reducing the Emergency Space is an inconsistent combination of ideas. Therefore, the SM Team rejected this Strategy. Strategy S-158 would construct 4 new HLW storage tanks (IL-1) and 42 smaller tanks (IL-16) under separate projects. Obviously, a simpler approach would be to increase the number of new HLW tanks to 5 to provide additional Emergency Space, since a single large tank designated for Emergency Space would be easier to monitor and maintain than 42 small tanks. The SM Team also rejected this Strategy.

9.2.5 Short List of Strategies

Four Strategies remained for the *Short List* after eliminating the Strategies that either did not contain a preferred idea from the groups of ideas that were functionally similar or was based on an illogical combination of ideas. The four remaining Strategies are shown in Table 9-9.

Table 9-9: Strategies Remaining for the *Short List*

Rank Order	Strategy No.	Ideas included in Strategy from the <i>Intermediate List</i> of Ideas
1	S-101	<ul style="list-style-type: none"> • Evaporate backlog waste (IL-10) • Reduce Emergency Space to 1,300 K-gals (IL-17) • Recover and reuse Tank 49 (IL-22) • Construct 4 New HLW Tanks (IL-1)
3	S-105	<ul style="list-style-type: none"> • Evaporate backlog waste (IL-10) • Reduce Emergency Space to 1,300 K-gals (IL-17) • Return Tank 50 to HLW Service – Construct new tank for storage of ETF Bottoms to increase efficiency of Z Area (IL-21) • Construct 4 New HLW Tanks (IL-1)
7	S-17	<ul style="list-style-type: none"> • Evaporate backlog waste (IL-10) • Reduce Emergency Space to 1,300 K-gals (IL-17) • Recover and reuse Tank 49 (IL-22) • Eliminate DWPF recycle to HLW Tank Farm by acid evaporation of DWPF recycle in Salt Cell (IL-11) • Return Tank 50 to HLW Service – Construct new tank for storage of ETF Bottoms to increase efficiency of Z Area (IL-21)
11	S-143	<ul style="list-style-type: none"> • Evaporate backlog waste (IL-10) • Recover and reuse Tank 49 (IL-22) • Return Tank 50 to HLW Service – Construct new tank for storage of ETF Bottoms to increase efficiency of Z Area (IL-21) • Eliminate DWPF recycle to HLW Tank Farm by acid evaporation of DWPF recycle in Salt Cell (IL-11) • Construct 4 New HLW Tanks (IL-1)

9.3 Process for Selection of Overall Strategy

After narrowing the number of Strategies to the *Short List* of four Strategies, the SM Team reviewed the four remaining Strategies with Stakeholders to obtain input on any concerns or advantages for any of these Strategies. Based on Stakeholder input and team expertise, the Strategy described below was selected.

9.3.1 Down-Selection of Strategy

The logic used to reach the overall Strategy was as follows:

- All four Strategies incorporated the need to evaporate waste and recover the space potential of that idea (IL-10). This idea is common to all of the Strategies and does not provide a means to discriminate between Strategies.
- Recovery and reuse of two HLW Tanks now associated with other programs is straightforward and relatively inexpensive. Recovery of Tanks 49 and 50 are associated with IL-22 and IL-21, respectively. Two Strategies (S-17 and S-143) used both of these ideas. The top-ranked Strategy (S-101) reduced emergency space rather than recovering Tank 50 for use while the next Strategy on the *Short List* (S-105) reduced Emergency Space instead of recovering Tank 49. Because of operational complexities identified by Stakeholders, reducing emergency space early in the study period, which these latter two Strategies require, is much less desirable than recovery of either Tank 49 or Tank 50.
- Three of the four Strategies on the *Short List* reduce the amount of Emergency Space maintained in the Tank Farm to the minimum volume specified in the Authorization Basis. The SM Team and Stakeholders agreed that this was acceptable, but only in the latter years of the study period (beyond FY2006) after other ideas are implemented that will significantly reduce the volume of influents into the Tank Farms. As noted above, two of the Strategies (S-101 and S-105) require a reduction in Emergency Space prior to FY2005. Strategy S-17 can tolerate a delay in the reduction of Emergency Space until FY2007 (or beyond) while Strategy S-143 does not reduce Emergency Space during the study period.
- Two of the four Strategies (S-17 and S-143) divert DWPF recycle from the HLW Tank Farm. The DWPF recycle would be evaporated in a new evaporator installed in the Salt Cell of the DWPF. Overheads would be sent to the ETF. Evaporator bottoms would be combined with incoming waste (sludge slurry) and frit for processing through the melter. Aqueous waste generated in the DWPF would no longer require space in the HLW Tank Farm. Not only does this idea increase available space in the Tank Farm, it also has a number of significant benefits unrelated to space:
 - It simplifies the operation of both the DWPF and the Tank Farm by eliminating daily transfers of DWPF recycle waste, effectively decoupling these processes.

- It reduces the risk of DWPF shutdown. As less space is available, a shutdown of Tank Farm evaporators could force a shutdown of the DWPF.
- It reduces a suspected cause of Tank Farm evaporator problems. Recent experience suggests that DWPF sludge carryover events, which release solids into the DWPF recycle, introduce compounds into the Tank Farm that can cause hard pluggage of transfer lines and degrade Tank Farm evaporator operation.
- It simplifies the operation of the Tank Farm by eliminating the DWPF recycle, the largest source of waste coming into the Tank Farm. Although the DWPF recycle is mostly water and occupies a relatively small volume after evaporation, it places a large load on the Tank Farm capacity to move and evaporate waste.
- Three of the Strategies (S101, S-105 and S-143) incorporate constructing four new waste tanks (IL-1). This idea has a major unfavorable impact on cash flow (financial penalty) in the early years of the study period. Construction of new tanks would extend the time required to complete the Site mission to empty and close all HLW tanks, requiring renegotiation of the Site Treatment Plan with the State of South Carolina and possibly the Federal Facility Compliance Agreement with the State and the Environmental Protection Agency.

A project to build new waste tanks should only be initiated if the project for the Alternative Salt Process is delayed. The proposed schedule used for evaluating this idea (IL-1) is based on an accelerated schedule that completes tank construction by FY2007. This schedule would be difficult to achieve, if work on this capital project does not begin in FY2000. The SM Team and Stakeholders consider a project for the construction of new HLW tanks to be a part of a longer-term Strategy, and it should only be started if additional space is required beyond 2009.

Based on the above logic, the SM Team determined that Strategy S-17 was the preferred combination of ideas even though it was ranked number 7 in the top eighteen Strategies and third in the *Short List*. This Strategy recovers tank space by evaporation, recovers and uses tank space in Tanks 49 and 50, diverts the DWPF recycle from the Tank Farm, and allows for the flexibility to delay the reduction of Emergency Space until late in the study period.

9.3.2 Review of Overall Strategy with WSRC Stakeholders

The overall Strategy and a proposed implementation schedule was presented to Stakeholders from DWPF, the HLW Tank Farm organizations and the HLWMD Program Board. A draft report was provided for a review and comment period following this presentation. Comments have been addressed in this report.

9.3.3 Impact Beyond FY2009 – Decision to Build New Waste Tanks

An initiative to build new waste tanks would not change the SM Team's Overall Strategy. The construction of new tanks would added to the other actions proposed if the Alternative Salt Processing Facility to process salt solution is not operational by FY2010.

The SM Team Charter² required the selection of a single Strategy for safely managing HLW until at least through FY2009. The schedule for the start-up of the Alternative Salt Process should be closely monitored to assure the new facility is operational early in FY2010. If significant delays in the startup are expected beyond FY2010, then construction of new HLW Tanks (IL-1) could be required to assure adequate space is available beyond FY2009.

A decision on the schedule for the Alternative Salt Process Facility must be made within FY2000. If the schedule for this new facility cannot meet the date assumed for this study (operational by the end of FY2009), a Project to build new HLW tanks must be initiated in FY2001 to assure the new tanks are ready for use beyond FY2009.

10.0 Glossary

1. Assumption: Not a validated piece of information, but sometimes required to facilitate other input or output activities. All assumptions carry risk and should be evaluated for consequences during the risk analysis stage.
2. Available Space (Gallons): That portion of HLW Freeboard that can be used for receipts of incoming waste. Available space is calculated by subtracting emergency space and working space from Freeboard.
3. Available Space Baseline (ASB): The set of assumptions used by the SM Team to define the Available Space if no actions are taken to increase Available Space. Using these assumptions, HLW Program Management determined the required increase in available space for each year from 2000 to 2009. Ideas and Strategies are measured versus this Baseline. The Baseline includes project missions for the tank farms and the assumptions that current tank farm operating practices and programs will continue. It does not include proposed changes to operating practices or changes in projected tank use.
4. Basis: The rationale, declaration, and/or starting point for a decision, method, and/or analysis.
5. Concentrated Liquor: Salt solution that has been evaporated to a specific gravity of 1.45 or greater.
6. Consequence of Occurrence: The impact(s) realized as a result of a risk occurring.
7. Constraint: Limits or thresholds that exist for a system, boundary, external interface, and/or component which have been established by programs, policy, standards, the physical laws of nature, or an empirical definition that must be addressed and compiled for all solutions/alternatives. Example: Recycle Flow may never exceed 100 gpm or have a rate change greater than 10 gpm/hr.

8. Demonstrated
(Proven) Technology: Technology which is commercially available and/or has been used in the nuclear industry.
9. Emergency Space: Minimum volume of space that must be maintained in Type III/IIIA tanks at all times, in the unlikely event of a tank leak. Currently the limit is set at 370" (1.3 million gallons), the TSR limit.
10. Freeboard: Space available for HLW storage that is not occupied. For example, the freeboard for a tank is the volume available at its operating limit minus the volume of waste in the tank.
11. Function: A qualitative statement of what a solution must do using a verb/noun format, e.g., "Pump water". A function must have at least one requirement.
12. Hold: A piece of information with some, but not complete, validation or traceability. There is a risk associated with "Holds" and they should be evaluated for consequences during the risk analysis stage.
13. Idea: A concept, if implemented, which would increase the amount of available space.
14. Increase in Available Space (Gallons): The increase in Available Space that results from implementing an idea or strategy relative to the Available Space Baseline.
15. Initial List: The list of ideas which passed the screening criteria.
16. Intermediate List: The list of ideas resulting in the highest Ten-Year Increase in Available Space (TIAS).
17. ISMS: Integrated Safety Management System (ISMS) is the methodology, applicable to the design, construction, operations, transition and D&D phases of a facility lifetime, which implements the DOE environmental, health, and safety programs as a single initiative through the application of the following five steps:
 - i. Define the work and how it is to be accomplished;
 - ii. Analyze the hazards entailed in performing the work;

- iii. Identify the controls necessary to perform the work safely and include them in design, construction, operational, transitional, and D&D procedures;
 - iv. Perform the work as planned, using adequately trained personnel; and
 - v. Evaluate how well the system worked, and feed back the evaluation results to reinforce and improve the process.
18. Life Cycle Cost: (LCC) equals acquisition costs plus ownership costs plus disposition costs, less any revenues, and less any salvage.
[LCC = TPC + O&M + D&D – Salvage]
(DOE LCC Estimating Course PMCE01, Version 1.0/July 1997)
19. Probability of Occurrence: The likelihood that a risk will be realized.
20. Ranking: The chronological ordering of *Intermediate List* ideas based on the numerical scores (high to low) resulting from the application of weighted evaluation criteria.
21. Requirement: A quantitative, measurable statement that specifies “how well” a function must perform, e.g., “20 gpm”. Requirements can be performance, interface, design criteria, and/or other constraints placed on a function.
22. Residual Risk Level: The significance of the risk remaining after credit is taken for proposed risk handling Strategies.
23. Risk An issue that may cause an uncertainty.
24. Risk Acceptance: A handling strategy that accepts the risk “as is”. This type of strategy does not attempt to reduce the risk level. Low and some moderate level risks are examples of the types of risks that are normally subject to being accepted.
25. Risk Handling Strategy: An approach which, if implemented, would eliminate or at least reduce the consequence of a risk occurring. Handling Strategies can be grouped into the following five categories:
- Risk Acceptance
 - Risk Mitigation

- Risk Reduction
 - Risk Transference
 - Risk Acceptance
26. Risk Level: The significance of the identified risk based on probability and consequence considerations.
27. Risk Mitigation: A handling strategy that mitigates the consequence of a risk. This type of strategy essentially drives the consequences of a risk to zero, eliminating the risk.
28. Risk Prevention: A handling strategy that prevents the risk from occurring (avoidance). This type of strategy essentially drives the probability of the risk occurring to zero, eliminating the risk.
29. Risk Reduction: A handling strategy that reduces risk, but does NOT eliminate it. This type of strategy reduces the probability and/or the consequences of a risk, but eliminates neither. The risk remains, but at a reduced level.
30. Risk Transference: A handling strategy that transfers the risk to a new owner (e.g., different project). The new owner must accept the risk before it can be transferred.
31. Sensitivity Analysis: Determining if there are large changes in the *Intermediate List* rankings based on small changes ($\pm 10\%$) in the evaluation criteria weights or UFV.
32. Stakeholders: Individuals or organizations potentially impacted by the recommended strategy(s).
33. Storage Space: Any container or location where HLW may be placed until it can be safely processed for final disposal.
34. Strategy: An idea or group of ideas from the *Intermediate List* which, if implemented, would increase the amount of available space in the time frame needed to satisfy the Strategy Input Package (SIP).
35. Subject Matter Experts: Individuals recognized by the SM Team as experts in a particular field(s).

36. Ten-Year Increase In Available Space (TIAS): The increase in Available Space (in gallons of salt) through the year 2009 relative to Available Space Baseline. This TIAS measures the total impact of an idea or Strategy over the period 1999 to 2009.
37. Total HLW Freeboard: The total freeboard in the SRS High-Level Waste System in tanks that are available for receipt of new wastes.
38. **TBD:** “To Be Determined” this is simply an information “placeholder”. NOT knowing something at the present time does not impede near-term development of design or Strategy input or output. There is risk associated with **TBD’s** and should be evaluated for consequences during the risk analysis stage.
39. Uncertainty: Potential variance in the cost or schedule of an alternative.
40. Utility Function (UF): A statement describing a specific characteristic of an attribute.
41. Utility Function Value (UFV): The numerical value assigned to a specific UF. The most desirable UF is assigned a value of 100 and the least desirable is assigned a value of zero.
42. Weighted Evaluation Criteria: Key attributes (and their relative importance to each other) considered in the evaluation of *Intermediate List* ideas. Attributes have the following characteristics:
1. Independence from each other.
 2. Address all necessary and sufficient functions and requirements for high risk issues identified in previous risk assessments.
 3. Universally understood by evaluators.
 4. Differentiate meaningfully among alternatives without bias.
 5. Be quantifiable (e.g., analysis, subject matter expertise, Team judgement, etc.)

- 43. Working Inventory: The combination of working space and available space.
- 44. Working Space: Volume reserved for waste receipts and evaporator operations. Currently 200K gallons per evaporator system and 100K gallons per area for waste receipts. Presently this is 500K gallons for H-Area, and 300K gallons for F-Area.
- 45. Uncertainty: Potential variance in cost or schedule of an idea or Strategy.

11.0 Acronyms

AGNS	Allied General Nuclear Service
ASB	Available Space Baseline
CIF	Consolidated Incineration Facility
CST	Crystalline Silicotitanate
DOE-SR	Department of Energy-Savannah River
DWPF	Defense Waste Processing Facility
EIS	Environmental Impact Statement
EM	Environmental Management
EPA	Environmental Protection Agency
ESP	Extended Sludge Processing
ETF	Effluent Treatment Facility
FFA	Federal Facilities Agreement
HLW	High Level Waste
HLWPE	High Level Waste Process Engineering
IAS	Increase in Available Space
ISMS	Integrated Safety Management System
ITP	In-Tank Precipitation
IWWP	Industrial Waste Water Permit
LAW	Low Activity Waste
LCAM	Life Cycle Asset Management
LCC	Life Cycle Cost
LDR	Land Disposal Restrictions
MAUA	Multi-Attribute Utility Analysis
NEPA	National Environmental Protection Agency
NRC	Nuclear Regulator Commission
OSR	Operational Safety Requirement
PA	Performance Assessment
R&D	Research & Development
SCDHEC	South Carolina Department of Health and Environmental

	Control
SE	Systems Engineering
SEMP	Systems Engineering Management Plan
SIP	Strategy Input Package
SM Team	Space Management Team
SMEs	Subject Matter Experts
SRS	Savannah River Site
STP	Site Treatment Plant
TCLP	Toxicity Characteristic Leach Procedure
TIAS	Ten-Year-Increase in Available Space
TPB	Small Tank Tetraphenylborate Precipitation
TSR	Tank Space Requirement
UF	Utility Function
UFV	Utility Function Value
WAC	Waste Acceptance Criteria
WCP	Waste Compliance Plan
WCS	Waste Characterization System
WDE	Waste Disposal Engineering
WPT(E)	Waste Pre-Treatment (Engineering)
WSMS	Westinghouse Safety Management Solutions
WSRC	Westinghouse Savannah River Company

12.0 References

1. HLW-OVP-98-0037, "High Level Waste System Plan, Revision 9.
2. HLW-SDT-99-0022, "Charter for the SRS HL Tanks Space Management Team".
3. WSRC-RP-99-00003, "System Engineering Management Plan (SEMP)"
4. HLW-PMD-99-0027, "Available Space Baseline for HLW Space Management
5. HLW-SDT-99-0036, "Phase I Strategy Input Package".
6. HLW-SDT-99-0189, "Desktop Procedures Compendium".
7. HLW-SDT-99-0055, "Results Report on The Identification of Concepts to
8. HLW-SDT-99-0063, "Results Report on the Determination of *Initial List* Ideas".
9. HLW-SDT-99-0066, "Results Report on the *Intermediate List* of Ideas based on Space Gain Contributions.
10. HLW-SDT-99-0167, "Results of the HLW Tank Space Management Team Criteria Selection, weighting, Utility Functions and Values, for Strategy Evaluations".
11. SRT-SCS-99-050, "Sensitivity analysis for HLW SM Team".
12. HLW-SDT-99-0147, Results Report on the Risk analysis of *Intermediate List* Ideas
13. HLW-SDT-99-0203, "Life Cycle Cost Estimate of Intermediate List Ideas".
14. HLW-SDT-99-0233, "Macro/Spreadsheet for Strategy Development"
15. HLW-DEN-99-0207, "Results Report of the Software Verification for Spreadsheets and Macros Implementing the SM Team Strategy Evaluation".
16. HLW-SDT-99-0220, "Results Report on the Development of Tank Space
17. HLW-SDT-99-0128, "Results Report on the Application of Weighted Evaluation
18. WSRC-RP-99-00005, "HLW Tank Space Management Team Final Report".
19. HLW-SDT-99-0008, "HLW System Plan (U), Rev. 10".